DECEMBER
22
1945

Electrical World

Automatic Net Interchange and Frequency Control in Northwest Power Pool

Comparative Properties of Synthetic Insulations

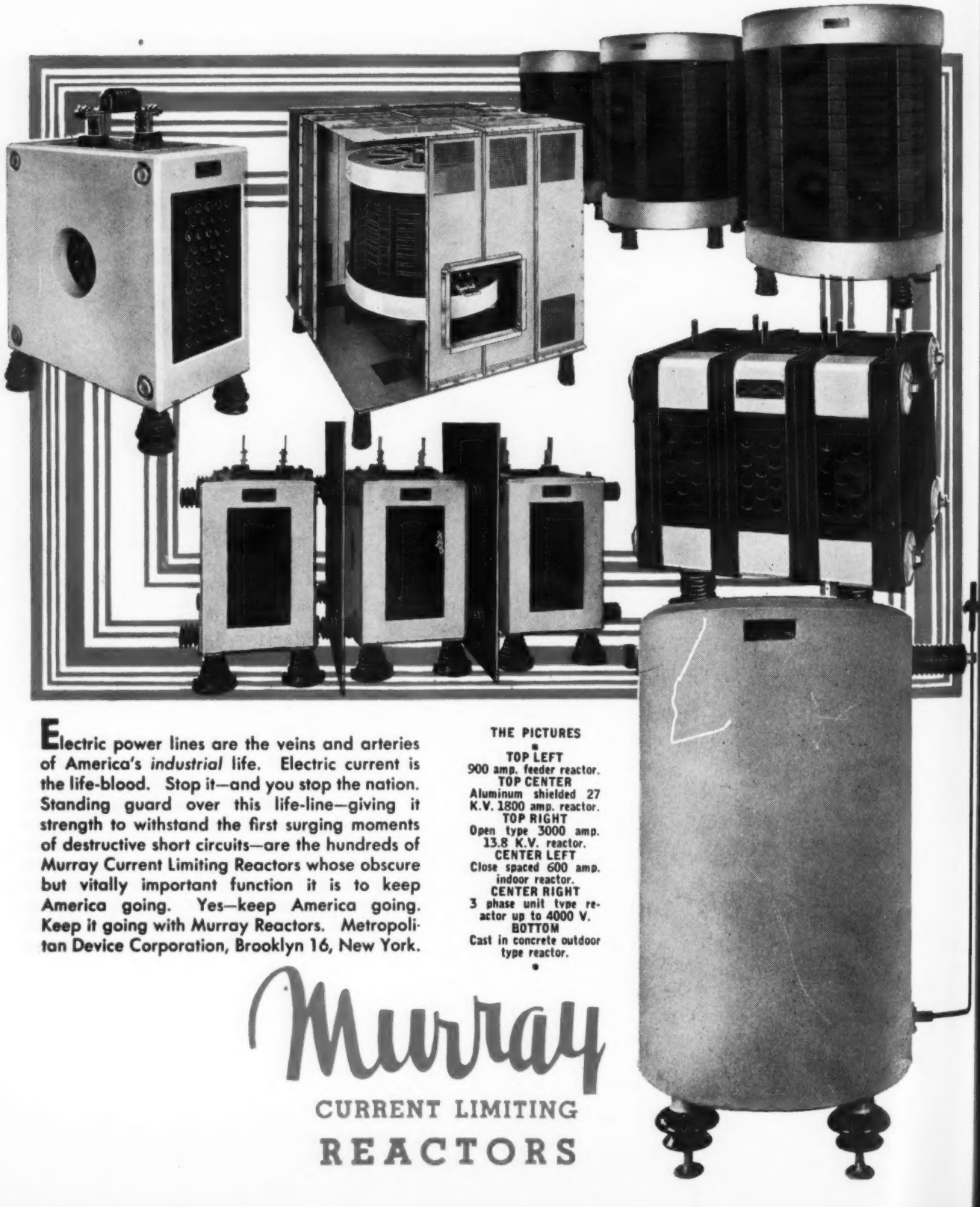
Sales Managers Aided by Adequate Customer Records

Increasing Sizes Decreases Fuse Operations

Utility Use of Electronic Equipment Extensive

ALUMINUM CHANNEL USED FOR 13.8-KV. BUS AT JENNISON STATION

GUARDING THE ARTERIES OF Electrical America!



Electric power lines are the veins and arteries of America's *industrial* life. Electric current is the life-blood. Stop it—and you stop the nation. Standing guard over this life-line—giving it strength to withstand the first surging moments of destructive short circuits—are the hundreds of Murray Current Limiting Reactors whose obscure but vitally important function it is to keep America going. Yes—keep America going. Keep it going with Murray Reactors. Metropolitan Device Corporation, Brooklyn 16, New York.

THE PICTURES

TOP LEFT
900 amp. feeder reactor.
TOP CENTER
Aluminum shielded 27 K.V. 1800 amp. reactor.
TOP RIGHT
Open type 3000 amp. 13.8 K.V. reactor.
CENTER LEFT
Close spaced 600 amp. indoor reactor.
CENTER RIGHT
3 phase unit type reactor up to 4000 V.
BOTTOM
Cast in concrete outdoor type reactor.

Murray
CURRENT LIMITING
REACTORS

Electrical World

FOUNDED IN 1874 • READ BY ELECTRICAL MEN FOR 71 YEARS

S. B. WILLIAMS.....*Editor*

A. E. KNOWLTON.....*Associate Editor*
FRANK R. INNES.....*Associate Editor*
R. M. SHOOP.....*Assistant Editor*
JULIUS C. MEIER.....*Assistant Editor*
KENNETH K. KOST.....*News Editor*
E. M. GLENNON.....*Assistant News Editor*
D. T. BRAYMER.....*Western Editor*
H. S. KNOWLTON.....*New England Editor*
W. C. HESTON.....*Pacific Coast Editor*
B. N. LARKIN.....*Washington Correspondent*

LEE H. HILL.....*Publisher*
M. S. MacNAUGHT.....*Manager*

DISTRICT MANAGERS
E. F. COFFEY.....New York
N. V. PALMER.....Boston
F. P. COYLE.....Philadelphia
W. W. GAREY.....Cleveland
S. H. BABCOCK.....Detroit
W. H. MENEILLEY.....Chicago
J. T. SCHAEFER.....St. Louis

ELECTRICAL WORLD

Published weekly. Price 25 cents a copy. Publication office 99-129 N. Broadway, Albany 1, N. Y. Allow at least ten days for change of address. Address communications about subscriptions to Director of Circulation, Electrical World, 330 West 42nd Street, New York 18, N. Y.

RETURN POSTAGE GUARANTEED

Subscription rates: In the United States, Mexico, Central and South American countries, $5 a year, $8 for two years, $10 for three years. Canada $6 for one year, $10 for two years, $12 for three years (Canadian money at par). All other countries $8 for one year, $18 for three years. Please indicate position and company connection on all subscription orders. Entered as second class matter November 16, 1936, at Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

Contents copyrighted, 1945, by McGraw-Hill Publishing Company, Inc. All Rights Reserved.

Branch Offices: 520 North Michigan Avenue, Chicago 11, Ill.; 68 Post Street, San Francisco 4; Aldwych House, Aldwych, London, W.C. 2; Atlanta, Ga.; Boston, Cleveland, Detroit, Los Angeles, Philadelphia, Pittsburgh, St. Louis, Washington.

McGRAW-HILL PUBLISHING CO., INC.
JAMES H. McGRAW
Founder and Honorary Chairman

Publication Office
99-129 North Broadway, Albany 1, N. Y.
Editorial and Executive Offices
330 West 42nd St., New York 18, N. Y.
JAMES H. McGRAW, JR.....President
CURTIS W. McGRAW....Senior Vice-President and Treasurer
HOWARD EHRLICH.....Vice-President (for Business Operations)
WILLARD CHEVALIER.....Vice-President (for Editorial Operations)
JOSEPH A. GERARDI.....Secretary
J. E. BLACKBURN, JR...Director of Circulation
Member A.B.P. Member A.B.C.
Cable Address McGRAW-HILL, New York

December 22, 1945 — Vol. 124, No. 25

Contents

Promise of Synthetics as Wire and Cable Insulations..... 52
R. B. McKINLEY, General Electric Co.

Automatic Load and Frequency Control in Northwest Power Pool.... 56
S. B. SMITH, Ebasco Services Inc., and M. L. BLAIR, The Washington Water Power Co.

Air Lift Elevates Ash in Sluicing System..... 61
A. W. GROENEWOLD and W. E. KINNEBREW, Public Service Co. of Oklahoma

Fuse Sizes vs. Blowings and Winding Failures..... 62
JOHN G. CHAREST, Pennsylvania Power & Light Co.

Simple Design, Reliability Keynote Jennison Station—II..... 64
W. W. PERRY and WALTER GREACEN, 3rd, New York State Electric & Gas Corp.

Adequate Customer Records An Aid to Sales Management..... 68
FRANK M. GEDDES, Commonwealth Edison Co.

Electronic Applications Extensive Among Utilities..... 70
N. H. EKVALL, Pennsylvania Electric Association

Editorials .....51 and 72

Washington Comment 74

News of the Week..... 75

HOW 83

Engineering Reference Sheets.....90 and 94

Load Building 110

New Equipment 118

News About People..... 127

Manufacturing and Markets..... 136

Sales Opportunities 140

Rural Allotments and Contracts..... 142

Recent Rate Changes..... 144

Book Reviews 145

Index of Advertisements 150

The contents of this issue are copyrighted and may not be reproduced without the permission of the copyright owners.

CHANGE OF ADDRESS

McGRAW-HILL PUBLISHING COMPANY,
330 West 42nd Street, New York 18, N. Y.
Director of Circulation:

Please change my address on Electrical World

Name .....

Old Address .....

New Address .....

New Company Connection .....

New Title or Position .....

FOR HOT LOCATIONS

PERFORMITE

PERFORMITE TYPE RH

CODE GRADE TYPE R

INSULATION WITH A

PAST . . . In service for 14 years

PRESENT . . . Long service life

FUTURE . . . Provides for expansion

HOW MANY OF THESE PERFORMITE POINTS are of special value to YOU?

1. Safely carries 33⅓% to 50% more current
   Recommended for **REWIRING JOBS** where increased capacity is required
   NEW INSTALLATIONS where future reserve capacity is desired
   HOT LOCATIONS (copper temperature limitation 75° C.)
2. Super-aging
   Resistance to heat and aging increases length of life far beyond ordinary rubber insulations
3. Non-corrosive Performite does not attack copper conductors
4. High Tensile strength and elasticity of insulation
5. Free-stripping saves installation time

Performite meets Underwriters' Laboratories requirements for Type RH Building Wire, ASTM Specs. D-754 for heat resisting insulation, IMSA Specs. for Municipal Signal Cables and many commercial specifications. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

HAZARD

insulated wires and cables for every electrical use

Electrical World

DECEMBER 22, 1945

A Pleasant Task

A LITTLE over twelve years ago when the New Deal swept into power on the issue that business had failed to provide employment, it became apparent that what business and industry had really failed to do was to build up good public relations. Came the war and American industry did the world's outstanding job and people said, "This is it"—industry has now created, not by the printed word but by quantity and quality of effort, the right kind of public relations, the kind that stands on a firm foundation and will withstand all storms.

The people who believed that were faulty in their reasoning. Of course, the public appreciated the record war job of industry and came to have its respect for American industrial ingenuity and "know-how" reaffirmed. At the same time, the public did not believe that industry made any great sacrifice while accomplishing the impossible in war production.

And now labor unrest is gnawing at industry's public relations. In spite of the fact that labor would be first to oppose nationalization of industry, it appears to feel it can effectively gain public support for its cause by undermining public confidence in management. So, the time is here again when industry must recognize the necessity of building good public relations.

Industry, however, is not really an entity but a composition of many parts. What the public comes to believe of the parts will characterize its impressions of industry generally.

One of those parts is the electrical manufacturing industry. Now that some of its alleged trade practices and policies are being singled out by labor for attack, it should be apparent that there is a public relations job to be done which no denial, no matter how strong, will accomplish. To be successful the battle for public opinion must be waged on a line of the manufacturers' choosing.

Electrical manufacturers as a class are great contributors to the public welfare but the general public isn't aware of it. It is axiomatic almost in the industry that regardless of how efficient a device is, it can be improved, with the result that the price the public pays per unit of performance has been constantly coming down while wages have gone the other way. To some degree the public is conscious of this with respect to the electric lamp and some appliances, but does the public know what the transformer, or the motor, or wire and cable, for instance, have contributed to employment, higher wages, comfort, leisure?

Naturally, it would be risky to predict what trend design might take in another decade or two but it would not be taking any great gamble to indicate what the public might expect in the way of improved performance and added benefits. From the more standardized lines to the specials, the record of the past has shown no deviation from the policy of greater public benefits. Why not talk about them then? Promises that can and will be kept are always more interesting than the achievements of the past.

In the next few years critics of industry will have many occasions to throw bricks. The electrical manufacturing industry, however, need experience little unpleasant effect if it will make a sincere effort to tell the public what it is contributing today to make tomorrow better.

With an industry that has so much to be proud of and so much to promise this ought to be a pleasant task.

Promise of Synthetics as Wire and Cable Insulations

Comparative properties of synthetic alternatives for rubber—Physical and electrical properties often differ in opposite directions—Buna-S, Buna-N, Butyl, Polyethylene, Polyvinylchloride, Silicone, all show merit for specific uses in field of electrical insulation

R. B. McKINLEY, Cable Division, General Electric Co., Schenectady, N. Y.

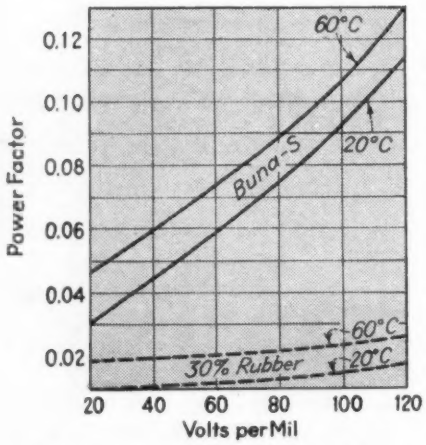


FIG. 1—Power factor plotted against voltage stress for rubber and Buna-S of similar type, namely, Performance Grade. Rubber has much lower power factors at the low stresses at both room temperature and at 60 deg. C. and a much flatter curve as the voltage stress is increased. Significance of the steeply rising curve for the Buna-S is brought out in Fig. 6

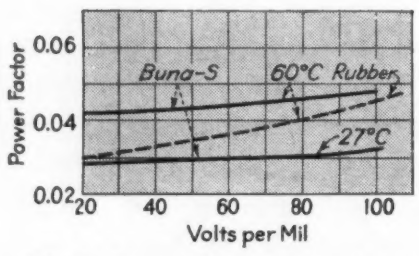


FIG. 2—Power factor versus voltage stress for Buna-S and rubber compounds of the ozone-resisting type. The rubber compound has a steeper curve than the Buna-S, but this is not true on all runs. Actual values of power factor at 60 deg. C. are lower for the rubber compounds throughout the range from 20 to 100 volts per mil

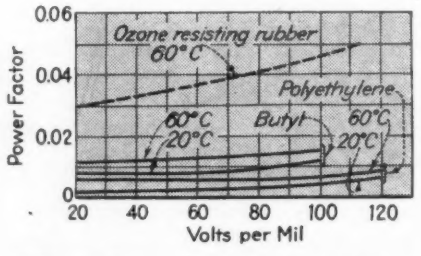


FIG. 3—Power factor versus voltage stress for Butyl and Polyethylene with ozone-resisting rubber insulation shown for comparison. Butyl and Polyethylene, especially the latter, have greatly superior qualities. Ratios of power factors for rubber and Polyethylene are from 15 to 1 at the low stresses to 8 to 1 at the higher stresses

SYNTHETIC RUBBERS are giving such a good account of themselves that it is not going to be necessary to wait until real rubber returns to be assured of high quality insulation. To what extent rubber will win back its previous place will depend on economics, but in the high-voltage field, especially, it is possible that one or more of the synthetics may replace rubber entirely.

Before the war a trend was noticed towards use of mineral-base compounds for voltages below 600 and ozone-resisting insulations for the general run of applications above 600 volts. With Buna-S compounds, this trend will undoubtedly be accentuated because of the higher dielectric losses of the standard Buna-S insulation and the excellent ozone resistance of the oil-base Buna-S.

While the Buna-S insulation can adequately satisfy the requirements for the present, Butyl and Polyethlene show great promise of becoming the insulations of the future especially in the high-voltage rubber field.

Several conclusions may be drawn from the information known today. On the basis of laboratory tests and service records over the past year, manufacturers and users have gained greater confidence in synthetic rubber compounds.

It might be interesting to take a glance at the more distant future to see what might be along the horizon. A little about silicone rubber might therefore be mentioned. A press-cured slab of silicone rubber was compared with a similar sample of Neoprene. Neoprene was chosen because of its excellent aging and heat-resisting ability. At 150 deg. C. (302 F.) the Neoprene had stiffened considerably after 75 hours and was brittle after 150 hours. The silicone was apparently unaffected after an aging period equivalent to 75,000 hours at 150 deg. C. The electrical properties of silicone rubber may be classified as good. With its remarkable heat resistance, this material may find a wide field in the low-voltage range even if it should not turn out to be applicable for the higher voltages.

Previous articles in ELECTRICAL WORLD have outlined the chemistry and relative characteristics of various synthetic insulations. This article reviews some of these properties in the light of further experience, and also shows results of electrical measurement that may have a bearing on cable operation.

In all cases comparisons of properties will refer to the compounded insulation and not the basic raw material. Proper accelerators, fillers, plasticizers, etc., have been added to give the insulation the classification noted.

Behavior of Buna-S

Buna-S has been used for almost 100 percent of the vulcanizable synthetic insulations since the conversion.

Buna-S compounds compare favorably with natural rubber in the physical properties important for wire and cable. The main difference is in tensile strength, which runs considerably lower for the synthetic. That high tensile strengths are not necessary for successful cable operation has been proven by the excellent service records of the ozone-resisting or oil-base rubber compounds whose tensile strengths were comparatively low.

Stability is always important. Therefore, how well does the material age? Long-time service records with Buna cannot be offered at this time to prove this point. However, various accelerated tests over prolonged periods indicate that aging qualities of the Buna-S are substantially superior to those of a similar compound made with rubber, at least in the higher temperature range where accelerated tests are conducted. With rubber the tensile strength usually showed greater depreciation than the elongation. In extreme cases the rubber would lose practically all of its strength and become soft and tacky. With Buna-S, the reverse is found. The compound tends to stiffen so that it is the elongation which deteriorates the more rapidly, the tensile strength often showing an actual increase.

Users always had a tendency to push the tensile strength requirements of rubber as high as possible. The same tendency has been apparent by some users in writing specifications for Buna-S compounds. Besides being more difficult for the manufacturer to make, the user might be calling for an insulation of greatly reduced life. A Buna-S compound with a tensile strength of 700 psi. and an elongation of 300 percent might be much superior to one having 1,000 psi. tensile but reduced elongation.

High Cable Temperatures

Buna-S insulation definitely will stand high temperatures better than similar rubber compounds. Those who are familiar with underground secondary network operation know

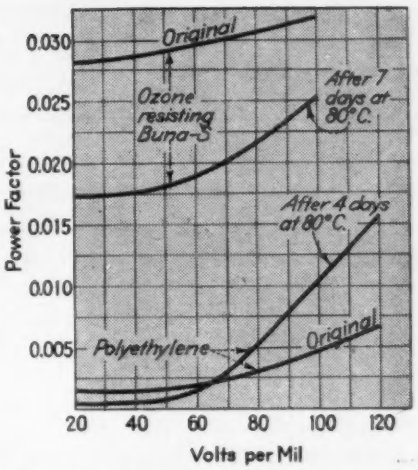


FIG. 4—Effect of heating on power factor of Polyethylene. The cable was heated for four days at 80 deg. C., after which readings were taken at 27 deg. C. Power factor has decreased at the lower stresses (a common occurrence in most insulations). However, as the stress increases, there is a very sharp increase in power factor which indicates ionization, mostly at the conductor surface due to voids or air pockets which become overstressed. For comparison, similar curves have been drawn for the ozone-resisting Buna-S, except that the heating period was more severe. While the Buna-S curve is somewhat steeper after the heating cycle, the cable does not show the hazardous condition brought out on the Polyethylene sample

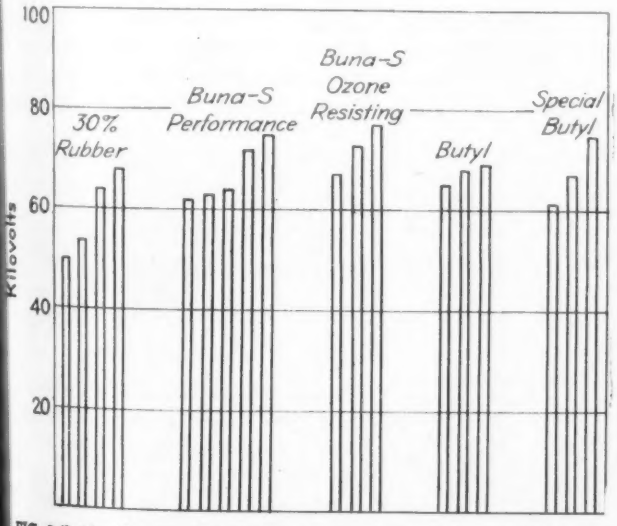


FIG. 5 (left)—Comparative voltage breakdown values. All tests on a No. 6 stranded conductor with 16/64-in. wall of insulations. Voltage was applied so that all samples broke down within one minute. From this test it might appear that the Performance Grade Buna-S would be better than the 30 percent rubber, as the average breakdown is about 10-kv. higher. Ozone-resisting Buna has highest average breakdown, being 15 to 20-kv. higher than the 30 percent rubber. Butyl and Special Butyl appear to be about on a par with Buna-S Performance

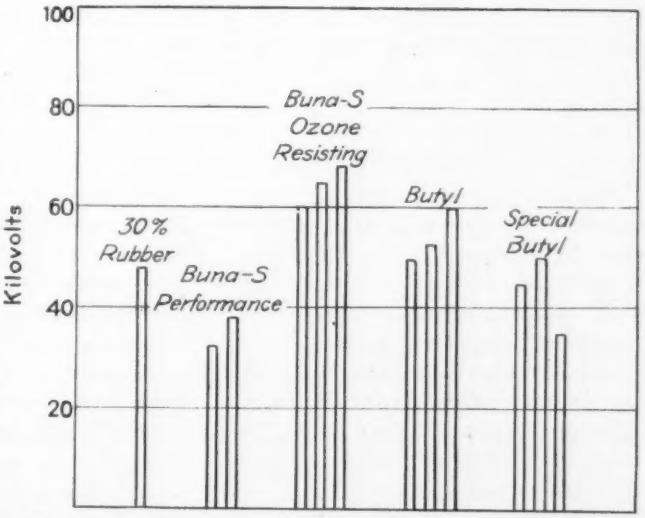
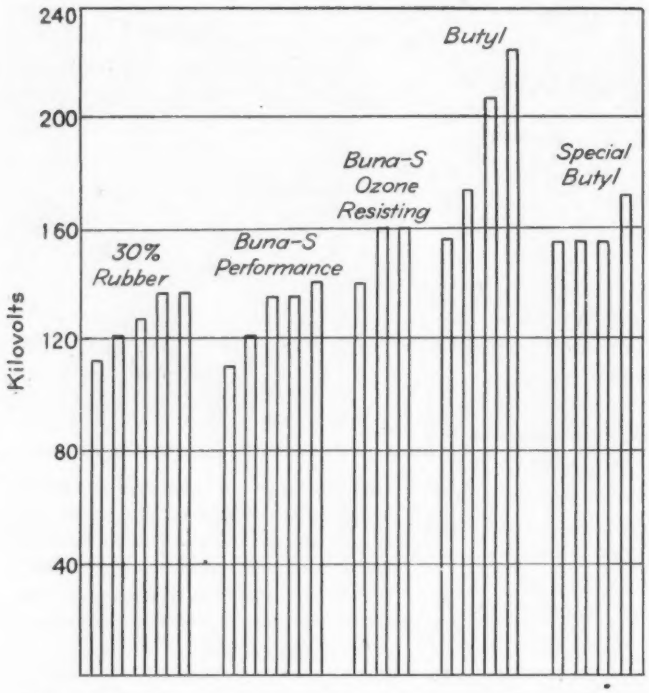


FIG. 6 (right)—Voltage applied in 2½-kv. steps starting at 25 kv. and each voltage step held for 30 min. Conductor No. 6. Insulation 16/64 in. Here the reverse of Fig. 5 is true. Actual values of breakdown for the Performance Buna-S are approximately ½ the short-time average. The explanation is simple: Fig. 1 showed the Buna-S as having much higher power factor values than the 30 percent rubber. Dielectric losses in the insulation are directly proportional to power factor. In the short-time test, heating of the insulation due to these dielectric losses did not have time to occur. In the 30-min. test this additional heating did not have time to show its effect. The Butyl compounds were disappointing and this is being investigated further



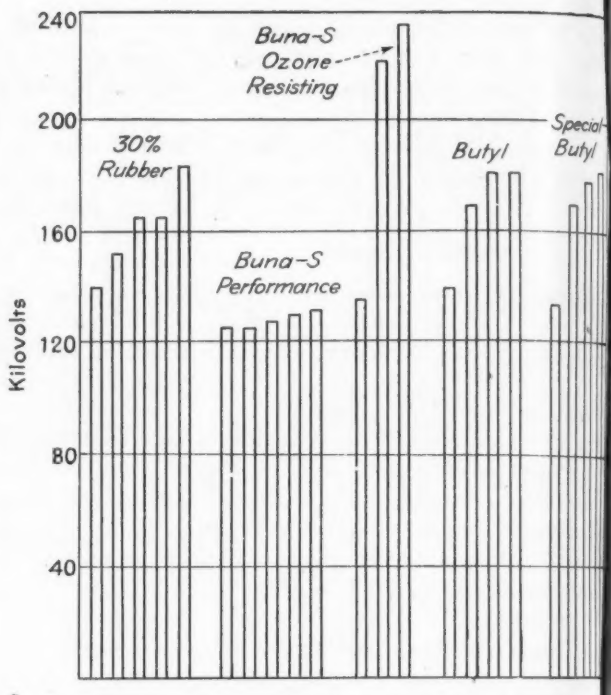


FIG. 7 (left)—Breakdown due to impulse surges using a 1½ by 40 wave on No. 6 conductor and 16/64-in. insulation. Buna-S Performance and 30 percent rubber compounds are on a par as might be expected. The ozone-resisting Buna-S runs about 20 percent above the Performance Compound. This makes it about on a par with ozone-resisting rubber insulations which are about the same percentage higher than Performance Grade rubbers. The Butyl is particularly good in impulse breakdown. This factor is of importance especially when cables are connected to overhead lines. Rubber insulations have always been weak in this respect when compared with varnished cambric and paper insulations at the higher voltages. Butyl might give an additional safety factor where a rubber-like insulated cable is wanted. The special Butyl insulations also look fairly good on impulse

FIG. 8 (right)—Results of tests in which the d.c. voltage was increased at the rate of about 3 kv. per second until breakdown occured. Ozone-resisting Buna-S and Butyl reverse positions when comparing d.c. and impulse breakdowns

that "limiters" are often used and set to blow when the cable reaches approximately 260 deg. C. because it was found that this was the so-called damage point as determined for rubber insulation.

A sample of Buna-S insulated cable was held at 260 deg. C. for 14 hours. Even after this severe test the insulation had an elongation of 100-200 percent whereas the tensile strength had depreciated only about 20 percent. From a visual examination, the cable still appeared serviceable, although the outside surface had toughened somewhat and took on a leather-like appearance. The greatest contrast to this performance was with an ozone-resisting rubber which generated smoke and showed porousness and flowing after only 10 minutes at the same temperature.

In electrical properties, rubber compounds are equal to or superior to Buna-S in every respect (Fig. 1 and 2). For low voltage work, however, the differences are not great enough to give concern as to the actual operation of the cable. Insulation resistance is the property where the greatest divergence exists. Normally, a Buna compound will have only 10 to 20 percent the insulation resistance of rubber. Fortunately, this is not a factor which would affect cable performance in most instances.

Ozone-Resisting Buna-S

Buna-S can also be used in making ozone-resisting, or oil-base insulations. In compounds of this type much less rubber or synthetic is used than in the more common performance or heat resisting insulations.

Oil-base compounds cannot be judged well by accelerated aging tests so predictions cannot be easily made. There is nothing, however, to indicate that the Buna compounds would not age as well as rubber.

In one important respect Buna insulations can be designed that are superior to conventional oil-base rubber compounds, and that is in ozone resistance. Ozone can cut mineral-base rubber insulation in a matter of seconds when the ozone concentration is only 0.010 percent. The standard test for ozone-resisting rubber insulation was that it had to withstand this same concentration for three hours which is quite a severe test. Many rubber oil-base compounds did not have much margin of safety. Corona resisting compounds made of Buna have often run three or four days

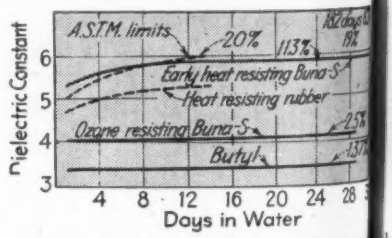


FIG. 9—Moisture absorbed indicated by change in dielectric constant (SIC) after immersion. More recent Buna-S compounds have better values than shown here. Ozone-resisting Buna and the Butyl have much superior moisture-resisting qualities than the standard type compounds. The tests on them were more severe than for the other compounds in that the temperature of the water was 50 deg. C., whereas the standard compounds were immersed in water at room temperature. Heat-resisting Buna compound was kept in the water for six months, at the end of which time the total change in the dielectric constant was 19 percent

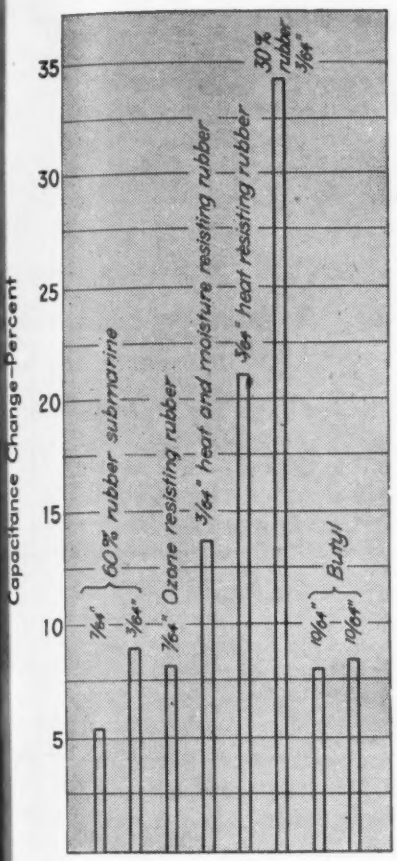


FIG. 10—Change in capacitance after one hour and after 15 days in water at 50 deg. C. Measurements made at stress of 80 volts per mil. Percent difference in capacitance was taken from the end of the first hour to 15 days instead of from the end of the first day to 14 days. Butyl is in a class with ozone-resisting rubber insulation, but not quite as good as the 60-percent type submarine rubber insulation. Two values are shown for the 60-percent rubber compound indicating that the insulation thickness has some bearing on the percent change. In the other cases the order of preference appears to be for the super-aging and moisture-resisting rubber insulation, heat-resisting rubber, and 30 percent rubber

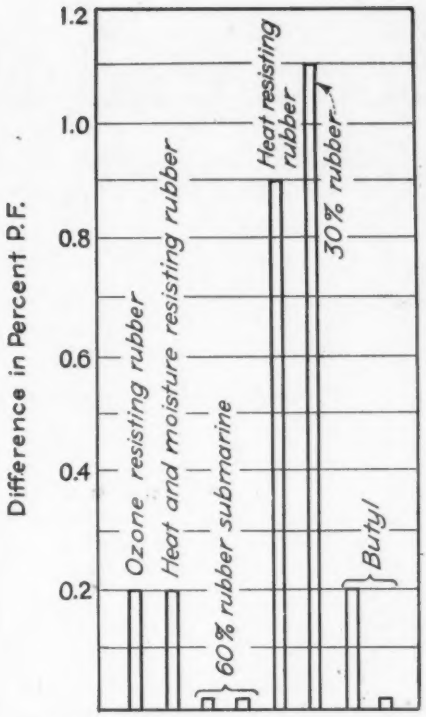


FIG. 11—Another proposed method for measuring moisture absorption differences in power factor taken after 15 days immersion in water at 50 deg. C. at 80 and 40 volts per mil. Here again the 60 percent rubber submarine compounds show up best, with Butyl and ozone-resisting rubber compounds also good. The super-aging and moisture-resisting rubber compound also looks good in this method

before stopping the test without showing any signs of distress.

Buna-N

Not much can be said about Buna-N synthetic rubber because its use in the wire and cable field has been very limited. Because of its poor electrical properties it could only be considered for jacketing purposes. Its physical properties and resistance to oil are very good, but compounds tried out to date fall below Neoprene in such important characteristics as tear resistance, and resistance to sunlight and ozone. Certain Buna-N-polyvinyl chloride combinations appear promising and are being investigated.

Butyl

Among the present synthetics Butyl undoubtedly holds the most promise for the future. Unfortunately, it has not been possible to obtain much of it for experimental purposes and development has therefore been somewhat delayed. However, all experiments to date continue to hold high promise.

Physical properties of Butyl are in the same range as those of Performance-type Buna-S insulations. In accelerated aging tests it appears to be greatly superior to rubber.

Electrical characteristics of Butyl are extremely good, as shown in the illustrations. Its insulation resistance is in the order of two or three times that of a standard 30 percent rubber insulation.

Butyl is also highly resistant to sunlight and ozone. In these respects it appears to be on a par with or superior to the Buna-S ozone-resisting insulation or, in other words, much superior to the ozone-resisting rubbers known in the past. It also has *very good low-temperature* and moisture-resisting characteristics.

Polyethylene

Use of Polyethylene as wire and cable insulation is one of the most important innovations during the war. War effort demanded an extremely low-loss, flexible, solid-dielectric insulation for cable which Polyethylene filled admirably and gave new concepts of insulation performance in some electrical properties. Polyethylene is a pure nonpolar hydrocarbon. In addition to excellent dielectric characteristics Polyethylene has very low moisture absorption. In spite of its hard paraffin-like appearance, it has very good low temperature characteristics. It is not affected by sunlight or ozone and aside from some softening does not appear to be affected by heat below 100 deg. C.

Much still remains to be done, however, with Polyethylene before it can be offered for high voltage use.

Polyvinyl-Chloride

Polyvinyl-chloride is not a new synthetic, as it has been used on cable for several years. Certain conditions have greatly widened its applications.

One of these is economics. The compound originally cost over a dollar a pound and its use, therefore, was restricted to certain applications such as machine-tool wiring, etc., where its greater cost would be justified. The cost now is in the neighborhood of 40 cents per pound so that more applications can be justified.

Another factor which affected its expansion was the development of different compounds to obtain certain desired characteristics. It is thus possible to design compounds that can be safely handled as low as —30 deg. C. for insulations and —50 deg. C. for jackets without fear of the compound cracking. Insulation resistance has also been greatly increased in some types of compounds.

To mention a few of the widening uses it might be pointed out that the railroads have installed over 8 million ft. on important signal circuits which call for the highest reliability. Series lighting circuits is another application which has utilized over 3½ million ft. in voltages up to 5,000 volts. Its use as a control cable for station wiring is also increasing.

Automatic Load and Frequency Control in Northwest Power Pool

Automatic frequency and load control for system net interchange prove solution to successful operation of extensive and complex power pool—Principles could be applied to other interconnected networks

S. B. SMITH, Ebasco Services Inc., and M. L. BLAIR, The Washington Water Power Co.

FORMATION of the Northwest Power Pool in 1942 created the need for a new type of automatic load and frequency control application called "net interchange control." This type of control has been in operation for several years and is considered one of the most important physical improvements in making the operation of the power pool successful. In general the application is such as to permit one system to undertake the primary frequency control for the pool with the other system controlling the net interchange load to their systems and at the same time participating in the frequency control.

The Northwest Power Pool* consists of approximately 4,000,000 kw. of interconnected generating capacity and a transmission system which extends approximately 1,300 miles from one end of the pool to the other. Many of the lines are of unusual length, one of which is the 275-mi. 161-kv. Montana-Utah interconnection. The principal interconnecting transmission lines of the pool are shown in the accompanying diagram. In this pool all system interconnections between utilities are continually closed in order to obtain the maximum transmission capacity among the different areas.

Each system of the pool has several ties to its various neighbors and with all these closed, a complex transmission network is formed with a considerable increase in transfer capacity. This is necessary and desirable in order to reduce overall system losses and to increase the economical utilization of all the resources available in the power pool. Furthermore, it was agreed by the power pool operating committee that each system of the pool would absorb its own system load changes without allowing them to pass over interconnections into other systems. This type of operation on such an intricate network called for new methods of controlling and accounting for the power interchanges over the multiple ties.

System Contains Many Loops

As can be seen from an inspection of the schematic interconnection and load control diagram (Fig. 1), many of the systems have interconnections that create transmission loops through other systems and in turn create super-imposed loops on these loops. It is obvious that in such a network the power interchange on any one interconnection cannot be controlled independently by changing generator output. The use of phase shifters was studied as a means of controlling ties independently, but this was rejected because of the magnitude of sizes and number required, and because of other undesirable features such as increased transmission losses, decreased system stability, and potential bottlenecks. To obviate the use of such devices to force power over paths where it would not normally flow, a scheme of power scheduling for billing purposes is used, together with a system of automatic "net interchange" load control. By these means each system controls the total algebraic sum of the scheduled power over all its interconnections rather than attempting to control any one interconnection independently. The system of scheduling power will be described in detail in a subsequent article.

The use of automatic net interchange control develops and uses the maximum transmitting capacity of the combined interconnected systems network by permitting the free flow of power. At times relatively large amounts of power can and do pass through each system of the pool, but in many cases the network creates a displacement of power flow in the various systems so that there is only an apparent passing through of power. All these flows are netted out and controlled with remarkable accuracy by the use of automatic net interchange load control equipment.

Automatic load control was necessary in order to hold to power schedules and to operate lines closer to their power limits by limiting unnecessary power swings on interconnections. Before the application of automatic load control the load changes of the entire pool were principally corrected by the frequency controlling plant, due to the inability of the other systems to hold to scheduled interchange by voice communicated readings and hand control of the system generation. During periods of maximum rapid load changes such as the on-coming morning load,

* "Northwest Power Resources Pooled for War," ELECTRICAL WORLD, March 4, 1944, page 59.

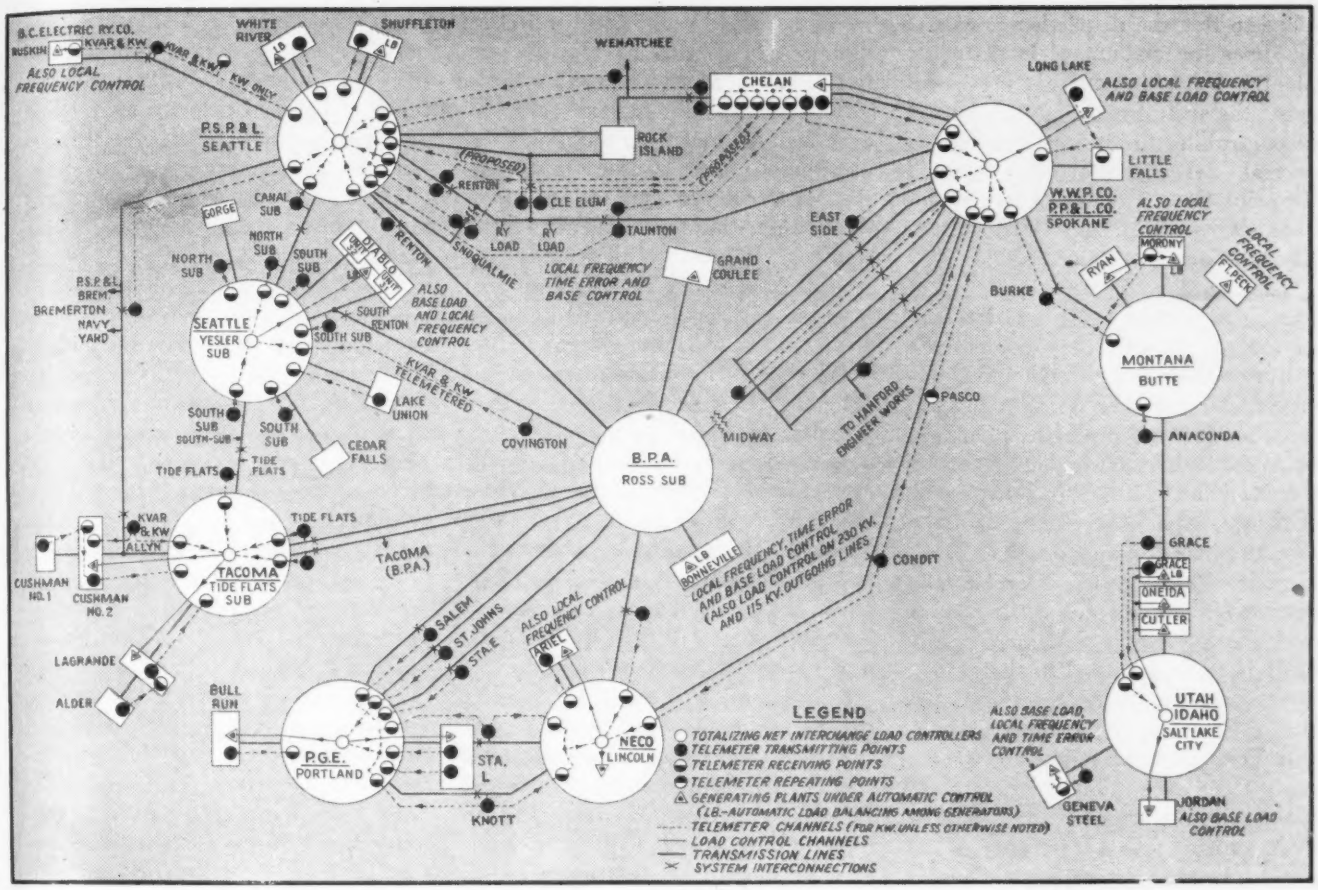


FIG. 1—Schematic interconnection, telemetering and load control diagram for Northwest Power Pool

the sudden noon drop, and the off-going load in the evening, the demand on the frequency controlling plant often exceeded its capacity to such an extent that the frequency deviated as much as $\frac{2}{10}$ of a cycle.

Automatic load control was also necessary in order to operate lines as close to capacity limits as possible for obtaining the maximum transfer of energy. On radially connected systems, where power swings are a definite limiting factor, hand control of the loading was singularly unsuccessful in accomplishing this, and in a network with a multiplicity of ties it was an almost impossible job for a dispatcher to determine and regulate his current "net interchange" by the normal means of communication. Under such conditions, average power transfers were relatively low. With the installation of telemetering and automatic load control the dispatcher was given an accurate picture of the net load of all the ties and also the supervised automatic control of distant controlling plant.

Net Interchange Control

The principle of net interchange control is to telemeter the power interchange on each interconnection of a particular system to that system's dispatcher's office and there totalize algebraically all these quantities to obtain the net amount of power being received or delivered. The power on the individual ties as well as the total system net interchange is generally recorded on graphic wattmeters in the dispatcher's office. The scheduled net interchange load (which is prearranged among dispatchers) is set manually on the net interchange graphic meter where it records the schedule with a different colored ink on the same chart on which the actual net interchange is recorded. A typical net interchange chart is shown in the illustration Fig. 2.

Automatic control, working from the net interchange meter and a master controller, is used to increase or decrease the selected controlling power plant output. The automatic controller in the dispatcher's office sends intermittent raising or lowering impulses over a control channel to the generator turbine governor in the system power plant selected to absorb the system load changes. This maintains the total system net interchange at the predetermined scheduled amount. There are approximately seventeen such control channels in the pool (usually employing carrier current) connecting master load controllers in dispatchers' offices with remote power plants under control. For example, the Washington Water Power installation, which was one of the first to be placed in service, controls either their Chelan or Long Lake hydro plants (as selected by the dispatcher) over a 167 mi. carrier channel from their dispatcher's office in Spokane.

The Washington Water Power and Pacific Power & Light companies are operated as one system and have nine carrier current telemetering channels to Spokane from their ties with Montana Power Co., Northwestern Electric Co., Bonneville Power Administration, and Puget Sound Power & Light Co. Similarly Puget Sound Power & Light controls the net of their ties to Washington Water Power, Bonneville Power Administration, and Seattle City Light by automatically changing the output of their White River hydro plant or Shuffleton steam plant. The power output of each plant in the pool under automatic control is telemetered back to the dispatcher's

office so that the dispatcher knows at all times the amount of load on the plant. Other systems in the pool using the same fundamental principle of controlling the net interchange of several ties are Portland General Electric Co., Tacoma City Light, Seattle City Light, and Northwestern Electric Co.

The Montana Power Co. does not operate as part of a transmission loop so that at present they control the power on their tie to Washington, permitting Utah Power & Light to control the Montana-Utah tie. Plans are being studied, however, for converting the Montana control to a net interchange control so it can control the algebraic sum of the two ties. B. C. Electric Railway Co. occasionally operates in parallel with the pool over a single interconnection, and equipment is to be installed on its system for the automatic control of this tie. Idaho Power Co. has multiple ties with Utah Power & Light Co. but no control is used on any of these since Idaho has no steam plants and delivers all of its hydro surplus to Utah whenever it occurs. Thus it may be considered for control purposes as part of the Utah system.

Automatic Controllers and Telemetering

All automatic load controllers, with one exception, are Leeds & Northrup proportional step impulse type, having provisions for controlling on flat frequency, selective frequency, flat tie line or tie line biased by frequency. In case system trouble causes a severe frequency surge, or an individual tie deviates more than a normal amount from any particular setting, these controllers automatically trip out of service and are restored manually by the system dispatcher when conditions return to normal. With the exception of Montana Power all master load controllers are located in the system load dispatchers' offices.

To accomplish the telemetering of interconnections and the output of plants under control to the various dispatchers' offices of the pool, approximately sixty telemeter channels are required. Most of these channels are carrier current operating over transmission lines or power company telephone lines, and terminate in the various dispatchers' offices where the recording meters and control equipment are located. One of these channels is over 360 miles in length and uses a carrier current repeater station; another is 320 miles long.

The telemetering channels are separate and distinct from the previously mentioned channels used for the remote control of generating plants regulating the system net interchanges. Practically all telemetering in the pool which is used in conjunction with load control equipment is of the Westinghouse highrate impulse type. The transmitter in this system of telemetering sends electrical impulses produced by a synchronous motor driven brush assembly revolving around a commutator fixed to the shaft of a watthour meter. The base rate of electrical impulses is the rate produced when the watthour meter shaft is not rotating. This impulse rate then will increase as power flow causes the shaft to rotate in one direction and will decrease when it rotates in the opposite direction. At the receiving end of the telemeter channel these impulses are converted into direct current proportional to the impulse rate, which in turn operates a load recording instrument calibrated in megawatts.

Primary Frequency Control

No automatic tie line load control is used on the Bonneville system since it usually functions as the primary frequency control system for the pool, controlling frequency at either the Bonneville or Grand Coulee plants. Leeds & Northrup frequency controllers are used at these plants and generally either two 108-mw. generators at Coulee or four 60-mw. generators at Bonneville plant are used for this purpose. Grand Coulee, which is usually used for frequency control, has the governors of the two controlling machines set with a flatter speed droop than the remaining machines in the plant so that the governors participate with the electrical controllers to give the best frequency control operation. The controlling governors have one-half of one percent droop on one generator and three-quarters of one percent on the other, whereas the remaining governors in the plant are set at a steeper speed droop ($1\frac{1}{2}$ to 3 percent depending on system conditions) to give base load operation with little response to normal frequency changes. At times when Grand Coulee is regulating frequency and there is excess capacity available, the Bonneville plant is operated to control the load on the 230-kv. lines connecting it to Grand Coulee. This method of operation in effect permits Bonneville to absorb some of the load changes in the nearby Portland area and maintains a more uniform line loading condition.

Grand Coulee and Bonneville plants are equipped with time error control and these are generally in service. However, in the event a system becomes separated from the others due to transmission system trouble, no effort is made to correct for time error on the separated system before reconnection since it is reconnected to re-form the pool as rapidly as possible. Any difference in time error as a result of being separated remains uncorrected.

During periods when the Grand Coulee and Bonneville plants are operating at full capacity with no regulating capacity available in them, frequency control is transferred to the Long Lake hydro plant of Washington Water Power Co. This plant has four generators totalling 70 mw. and automatic load balancing equipment is used to equalize the load on the four units. Occasionally the Chelan hydro plant has been used in conjunction with Long Lake for joint frequency control.

The frequency band of the pool averages approximately plus and minus 0.04 to 0.06 cycle and seldom exceeds plus and minus 0.08 cycle as may be seen by the sample chart shown in Fig. 2. In order to maintain this band, normal load swings on the frequency controlling plant are approximately 20,000 kw. The power output chart of a primary controlling unit at Grand Coulee is also given in Fig. 2, covering the same time interval as the other charts shown, when only one generator was used for control. System tests indicate that it requires approximately 50,000 kw. of generating capacity to shift the pool frequency 0.1 cycle.

Tie Line Bias

Load controllers are generally operated on the type of control called "tie line biased by frequency" or "tie line bias" for short. This type of control permits the tie lines to vary from schedule whenever they have a positive deviation with frequency in the direction to assist frequency. The tie

lines will thus be restored to schedule when the frequency returns to normal, without plant output changes by the tie line controllers. This type of operation reduces the number of load changes on all controlling plants, because plants controlling load do not make unnecessary changes to correct tie line deviations which would be automatically corrected when the frequency is restored to normal by the primary frequency controlling plant. For example, a bias setting of 10 mw. per 0.1 cycle permits or causes the net interchange on the tie lines to go off schedule 10 mw. in the direction to help correct for the speed deviation if the freqeuncy is off 0.1 cycle from 60.0 cycles, or 5 mw. if the frequency is off 0.05 cycle.

Experience in the pool has shown that the best practice is to have sufficient bias setting to cause a definite deviation from tie line load schedule materially to assist the frequency. In this way the load controlling plants participate in the control of frequency and reduce the magnitude of load swings required on the frequency controlling plant. As a result better tie line and frequency control are obtained with fewer load changes on all generators.

Whenever a transmission system bottleneck develops due to heavy deliveries into an area, power transfer over such a circuit is controlled to a closely fixed value to obtain the maximum interchange. The control equipment is operated to control such ties at a flat interchange, allowing other ties to the system to carry loads in proportionate values without regard to the total system net interchange. To accomodate the equipment for this operation the instruments were designed so that any number of telemetered ties could be disconnected from the control by switching in the dispatcher's office, permitting the net interchange meter and controller to totalize only the tie or ties to be controlled. Such operation usually is temporary and necessary pending the completion of reinforcements to the transmission system, or during temporary heavy power transfers into a system. Changing from tie line bias to flat tie line is done by a control switch at the control equipment.

Where more than one plant is controlled from the same master controller, special devices are used to adapt the length and number of raising and lowering impulses to the different response characteristics of the different plants. This response of course depends on hydraulic and electrical characteristics of the plant as well as the type and condition of the turbine governor.

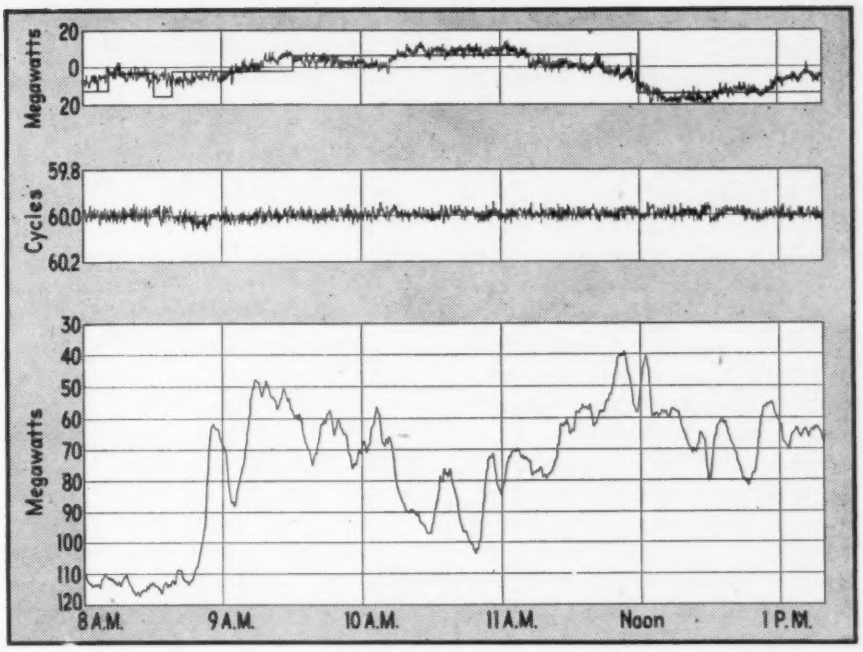


FIG. 2—Typical charts showing net interchange, pool frequency and load on frequency controlling unit. Upper chart—The Washington Water Power system net interchange. Straight line is from schedule pen located 5 min. ahead of actual interchange. Center chart—Power pool frequency. Lower chart—Power output of Grand Coulee frequency control unit

Governor Settings

In placing automatic control equipment in service it was usually necessary to change the normal governor adjustments on load controlling plants in order to obtain the best response for automatic operation. The governor adjustments usually were increases in the speed-droop of the load controlling plant so that the governors would be less responsive to frequency changes, and adjustments in the dash pot compensation, sensitivity, and other governor parts to minimize the load drift of hydro units. In some stations it was found that units would continue to change output for an unreasonable length of time after the synchronizing motor had started and stopped following the receipt of load changing impulses from the automatic control. On certain governors it was found necessary to reduce the lap on the main distributing valve in order to reduce this drift of load. In all cases the governor had to be adapted to make load changes as rapidly and uniformly as possible when receiving impulses from the load control equipment, also to remain inactive immediately on cessation of such impulses. One of the most important considerations in obtaining a smoothly functioning governor was the correction of loose linkages in the governor mechanisms.

Where steam units are under automatic control, the question of uniform incremental regulation of the governor became important. It was found that on some units the amount of load change obtained from a control impulse varied considerably, dependent on the amount of initial load on the turbine. In such cases the varying load response, as each steam valve opened in sequence, did not permit smooth load control. Some improvement was made by increasing speed-droop in order to decrease the response to frequency changes, but it was found desirable to redesign the valve cam operating mechanism to give a more uniform straight line relation between power output and movement of main valve operating mechanism. Redesigned cams and camshafts for operating the steam valves are now being installed on some of the systems.

In order to test and adjust the governors it was necessary to use a special high-speed, dead-beat, photocell meter which records on one chart two mechanical movements (such as main gate arm and pilot valve on

hydro units) as well as instantaneous frequency and power output of the generator. By repetitive cut and try testing and studying the results on the charts of this meter, the various adjustments of the governor can be made to obtain the best response of the unit. This is a General Electric Co. meter owned by Washington Water Power and is rented to the other utilities whenever needed.

In hydro plants under control where there is more than one generator, it is usually the practice to control all units simultaneously to increase speed of load changes and to gain plant efficiency. In such cases automatic load balancing is used on the units except in a few cases where governor characteristics are good enough to maintain nearly the same load response on each unit. This latter method is never so satisfactory because it requires manual changes from time to time by the plant operator to equalize the load on the units. These manual changes usually impose additional duties on the automatic equipment to correct the ties which have thus been caused to deviate from schedule.

Steel Mill Load Swings

Since the formation of the Northwest Power Pool and the installation of automatic load control equipment. the Geneva Steel mill in Utah has been connected to the pool. The rolling mills there have motors as large as 7,000 hp. and it is possible for several of these to reach their peak loads simultaneously and to create swings of 35,000 kw. in 10 seconds.

Ordinary load control equipment is not fast enough nor are hydro units or the usual governor equipment on steam units fast enough to make load changes at this rate of approximately 3,500 kw. per sec. Therefore these swings appear throughout the pool and tend to cause unnecessary swings in the load and frequency controllers. Plans have been prepared for installing special valve operating equipment and special high speed automatic load control equipment on the 50,000-kw. steam turbo-generator at Geneva so that most of these swings can be absorbed on this unit without affecting the interconnected systems.

System Benefits Obtained

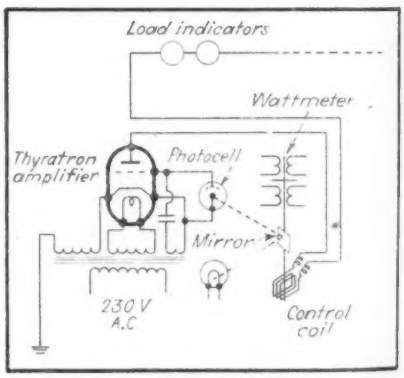
On the whole, the automatic load control installed throughout the Northwest Power Pool has proved to be a satisfactory solution to one of its primary problems and has now become an essential part of pool operations. It is felt that automatic "net interchange control" in particular has possibilities of use on many other systems which operate with closed interconnections with their neighbors, whether the systems form transmission loops or not.

In many instances since the formation of the pool, the use of automatic load control equipment has made possible the continuous transfer of power at maximum capacity of the interconnections between all major areas: from Spokane into Seattle-Tacoma; from the Bonneville system into Portland; from the Bonneville system into Spokane; from Montana into Washington; from Washington into Montana; and from Montana into Utah. The energy capacity of the pool was increased by the additional transfer into distant storage reservoirs of surplus hydro energy, which otherwise would have gone to waste, for use in anticipated energy shortages during critical periods. At other times maximum transfers were made to conserve critical fuels at steam plants and to supplement the resources of local areas. Another non-materialistic, but none the less real, benefit of the automatic load control is the resulting good relationships among dispatchers because of their ability to hold the ties closer to mutually agreed upon scheduled amounts and to operate the combined systems as a coordinated whole.

Telemeter Uses Photocell

Controlled light-beam incidence on a photocell connected to the grid of a thyratron is the crux of a telemetering scheme used by the South Wales Power Company to telemeter the summed output of four generators at one station and six at another station 16 miles away. The pilot circuit used has a resistance of 500 ohms.

As described in the *Electrical Review*, an Everett Edgecumbe-Tinsley auto-repeater is used. The polyphase wattmeter shaft carries a mirror and a control coil in lieu of the customary spring. When a change in load occurs the meter deflects up-scale and the mirror-reflected beam of light sweeps across the photocell at a speed proportional to the increase over the previous value of watts load. Duration of the incidence on the photocell is thus proportional to the rate of increase of load.



BRITISH auto-repeater basis for megawatt telemetering uses thyratron and photocell in conjunction with mirror on shaft of wattmeter

Restover Equilibrium

In parallel with the photocell is the condenser F and as photocell current changes under the influence of the incident light, the potential and phase of the voltage at the junction between condenser and photocell changes and affects the grid potential of the thyratron. In consequence the thyratron passes, over the line and through the control coil, a current of such magnitude as to restore the wattmeter to equilibrium at the new value of load. The function is, of course, reproducible at the receiving end.

Travel of the beam continues until the control current is just sufficient to make the two opposing torques again equal when the movement will stop. The net result is that the mean value of current flowing is directly proportional to the torque on the induction disc of the wattmeter and thus to the power measured. No frictional or other load is imposed on the wattmeter movement. The control current is only a few milliamperes and any reasonable number of moving-coil indicating instruments can be placed in series to repeat totals at as many points as is desired.

Air Lift Elevates Ash in Sluicing System

Water-borne ash lifted by pneumatic means without conveyor—Well sunk 60 feet—Air at 25 to 50 psi.—Ash settled out—Water recirculated

A. W. GROENEWOLD and W. E. KINNEBREW**

A RECENT CHANGE in fuels, from gas to stoker-fired coal, at the McAlester Plant of the Public Service Co. of Oklahoma precipitated the development of a hydraulic sluicing system for gathering and elevating ash from furnace pits in the plant basement to a settling tank at ground level. Unique feature of the system is its use of air-lift pump to elevate the water-borne ash, eliminating need for mechanical conveyor equipment.

The accompanying schematic diagram shows the system. Ash is periodically sluiced from furnace pit openings into screened hoppers along an 8-in. ash discharge header. Sluicing is directed into furnace pits by ¾-in. jets, tapping a 100-psi. water line. The jets are adjustable to allow water to be directed into furnace pits in any desired direction.

The water-ash mixture in the ash discharge header flows into an air lift pump at a point about 14 feet below ground level and is discharged at ground level into a settling tank.

The air-lift is of conventional design. It consists of a 12-in. well sunk 60 feet below ground level and containing a 7-in. drop-pipe terminating in an open end 12 to 18 inches above the well bottom. A 1½-in. air line extending down inside the drop-pipe carries compressed air at 25 to 50 psi. for operation of the lift. This pipe discharges compressed air 6 inches above the bottom of the drop-pipe and the resulting turbulence, at some sacrifice in efficiency, prevents the heavy slag and clinkers from settling out when making the 180-deg. turn at the bottom.

Discharge of air at the bottom of the drop-pipe forms a mixture of air, water, and ash within it that is lighter than the surrounding column of solid water and ash outside the drop pipe. Consequently, the lighter mixture rises to the top of the drop-pipe and is discharged continuously into the settling tank. Here the ash settles out and the water is picked up by a 300 gpm. underwater sump pump and recirculated through the sluicing system. Ash is removed from the pit with a clam shell-crawler crane combination, for disposal.

Designed for Submergence

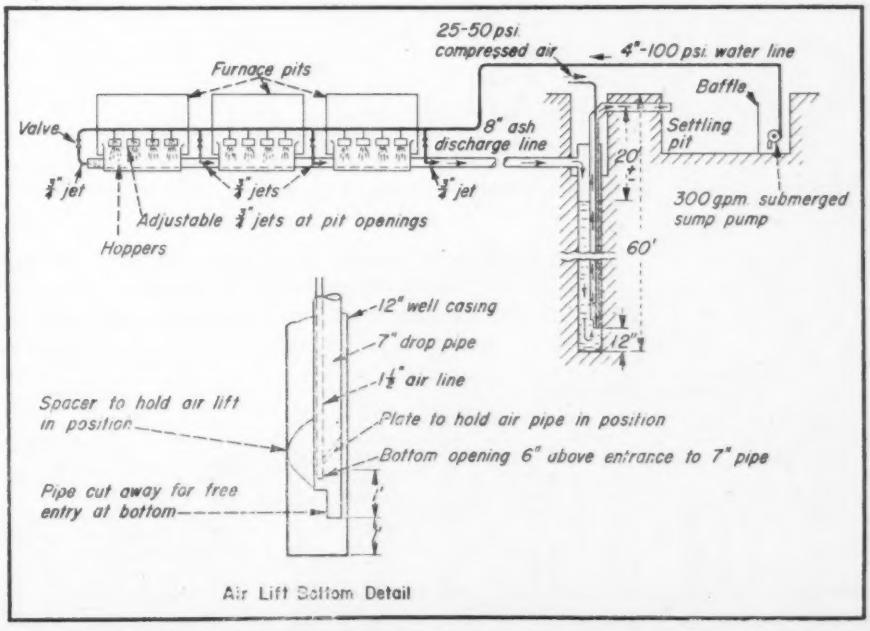
The air-lift at McAlester was designed to operate at 65-70 percent submergence, i.e., with two-thirds of the total drop-pipe length (measured from discharge to bottom end) submerged when pumping. This is considered the optimum percent submergence, for such pumps have lifts out to about 100 feet. Lift of a pump of this type is the distance from the discharge end of the drop-pipe to the level of the solid water in the well while pumping, in this case about 20 feet.

To operate the lift, flow of water through the sluicing jets in the furnace pits and the air pressure supplied to the lift must be adjusted so that the flow of ash and water to and from the lift is balanced. In the event the air lift fails, or is overloaded, rising water in the well actuates an alarm circuit warning the operator before well overflows through the ash discharge line into plant basement.

Before a clinker screen was installed in sluicing hoppers at the furnace pit, the air lift clogged occasionally. Stoppages can be removed by closing the gate valve in the discharge of the drop-pipe and building up enough air pressure to blow air backward through the lift.

A considerable saving of critical materials was effected in this installation, through use of the used pipe and fittings and use of an ancient submerged type vertical pump which was fitted with a new shaft made from the old drive shaft.

This arrangement has been working satisfactorily at McAlester for about one year and has proven to be an efficient, relatively trouble-free system which should prove ideal for small coal-fire plants.



HYDRAULIC ASH SLUICING SYSTEM uses air lift pump to elevate mixture from plant basement to settling tank at ground level

* Public Service Co. of Oklahoma, Tulsa.

Fuse Sizes vs. Blowings and Winding Failures

Study by PEA committee directed at conserving wartime manpower and transportation through choice of rating for minimized burnouts of distribution transformers and fuse replacement

JOHN G. CHAREST, Pennsylvania Power & Light Co., Hazleton, Pa.*

COMMITTEE STUDY of distribution transformer failures and protective fuse performance confirms the common inference that increasing the size of fuses very definitely decreases the number of fuse operations. This conclusion is drawn from analysis of reports from eight member companies of The Pennsylvania Electric Association for the three years 1942-1944 and covering 222,735 service years of 2.4-kv. transformers from 1½ to 15 kva. protected with fuses from 3 to 100-amp. ratings.

There is still, however, no very definite relation discernible between fuse ratings and winding failures from all causes. In fact there is an inconsistency in the rate of failures reflected by a downward trend in failures due to overload with increase in fuse rating, and an increase in failures due to secondary faults with increase in fuse ratings. The apparently high failure rate of transformers fused at 50 amp. should be considered in the light of the limited number of service years (1802) on which it is based.

Whether application of proportionately larger fuses will hold transformer failures within reasonable limits and at the same time conserve

* Superintendent of Lines and Substations.

Table II
2.4-Kv. Single-Phase Distribution Transformer Fuse Rating Study
Transformer Winding Failures 1942-1943-1944

Kva.	Fuse Amp.	Service Years	No. of Winding Failures					Winding Failures in Percent of Service Years				
			Lightning	Overload	Sec'dy Faults	Misc.	Unknown	Lightning	Overload	Sec'dy Faults	Misc.	Unknown
1½	50	25	1	0	1	0	0	0.40	0.00	0.40	0.00	0.00
	15	2,843	34	26	10	0	18	1.26	0.92	0.35	0.00	0.64
	10	25,571	138	22	49	21	35	0.54	0.09	0.19	0.08	0.14
	7	3,378	18	16	9	5	1	0.53	0.47	0.27	0.16	0.03
	5	10,882	161	67	30	7	114	1.48	0.61	0.28	0.06	1.05
	3	1,632	12	2	5	0	5	0.74	0.12	0.31	0.00	0.31
3	50	240	0	0	3	0	2	0.00	0.00	1.25	0.00	0.83
	15	8,060	38	19	46	0	30	0.46	0.24	0.57	0.00	0.37
	10	12,290	56	5	7	5	17	0.45	0.04	0.06	0.04	0.02
	7	3,414	12	8	9	1	2	0.35	0.23	0.26	0.03	0.06
	5	16,700	139	16	29	3	93	0.84	0.10	0.17	0.02	0.55
5	50	948	5	0	5	0	5	0.53	0.00	0.53	0.00	0.53
	15	13,218	51	16	76	4	29	0.38	0.12	0.57	0.03	0.22
	10	14,415	52	5	12	9	18	0.36	0.03	0.08	0.07	0.13
	5	14,924	84	8	26	3	80	0.56	0.05	0.17	0.02	0.54
7½	50	589	3	0	4	0	1	0.51	0.00	0.68	0.00	0.17
	15	6,419	24	2	33	3	17	0.22	0.03	0.51	0.05	0.02
	10	17,586	55	4	17	1	24	0.31	0.02	0.10	0.00	0.14
10	100	1,234	3	0	7	0	6	0.24	0.00	0.57	0.00	0.49
	30	9,145	20	1	55	2	15	0.22	0.00	0.60	0.02	0.16
	15	13,489	37	11	19	1	9	0.27	0.08	0.14	0.07	0.06
	10	12,789	52	10	11	6	30	0.41	0.08	0.09	0.05	0.23
15	100	2,285	5	0	3	0	8	0.22	0.00	0.13	0.00	0.36
	30	11,909	19	8	23	5	5	0.16	0.07	0.19	0.04	0.04
	20	6,343	14	3	0	0	2	0.22	0.05	0.00	0.00	0.03
	15	12,407	38	6	6	0	36	0.31	0.05	0.05	0.00	0.29

Table I
Single-Phase Distribution Transformer Fuse Rating Study
2.4-Kv. Class—1½ to 15-Kva. Inclusive
(Composite of 8 Companies—1942-1943-1944)

	Winding Failures in Percent of Service Years Total							Fuse Operations in Percent of Service Years Total						
Fuse Amp.	Service Years	Lightning	Overload	Sec'dy Faults	Misc.	Unknown	Percent Fail.	Service Years	Lightning	Overload	Sec'dy Faults	Misc.	Unknown	Percent Oper.
100	3,519	0.23	0.00	0.29	0.00	0.40	0.92	3,519	0.43	0.00	0.06	0.25	0.48	1.25
50	1,802	0.50	0.00	0.72	0.00	0.44	1.66	1,802	0.61	0.00	0.00	0.28	0.17	1.06
30	21,054	0.19	0.04	0.37	0.03	0.09	0.73	21,054	1.30	0.00	0.37	0.35	0.28	2.40
20	6,343	0.22	0.04	0.00	0.00	0.03	0.30	6,343	0.60	0.08	0.24	0.35	0.33	1.61
15	56,436	0.37	0.14	0.34	0.02	0.25	1.13	45,417	2.84	0.00	0.59	0.38	0.37	4.81
10	82,651	0.40	0.06	0.11	0.06	0.15	0.81	64,093	2.75	0.07	0.49	0.68	0.61	4.60
7	6,792	0.44	0.35	0.27	0.09	0.04	1.19	6,846	3.10	0.04	0.61	0.08	0.10	4.23
5	42,506	0.90	0.21	0.19	0.03	0.08	2.02	11,660	6.10	0.10	1.05	0.06	0.47	7.68
3	1,632	0.74	0.12	0.31	0.00	0.31	1.47	1,632	6.70	0.00	1.00	0.00	0.73	8.40
Total	222,735	0.49	0.11	0.21	0.03	0.27	1.12	182,366	2.58	0.04	0.46	0.40	0.40	3.90
Percent of failures	.....	43	10	19	3	25	100.00	Percent of operations	66	1	12	11	10	100.00

manpower and transportation by keeping fuse operations down to a reasonable minimum is not, therefore, conclusively established by the data accumulated and studied. Many undefined details such as shielding, length of secondary runs, relative lighting frequency and intensity, effectiveness of grounds, etc., will manifestly need to be analyzed.

Studies would need also to be continued to cover a substantial number of units for each influencing condition or combination and for a prolonged period in order to resolve the uncertainties which remain. At present it is possible only to deduce that larger fuses do, in general, reduce fuse operations.

Accompanying tables present the data, Table I for the composite for all six-kva. ratings for three years, Table II for 3-year winding failures, Table III for 3-year fuse operations. Other tables show the experience for the separate years.

Table III

2.4-Kv. Single-Phase Distribution Transformer Fuse Rating Study
Fuse Operations 1942-1943-1944

Kva.	Fuse Amp.	Service Years	No. of Fuse Operations*					Fuse Operations in Percent of Service Years				
			Lightning	Over-load	Sec'dy Faults	Misc.	Unknown	Lightning	Over-load	Sec'dy Faults	Misc.	Unknown
11/2	50	25	0	0	0	0	1	0.00	0.00	0.00	0.00	4.00
	15	2,843	153	0	2	7	9	5.40	0.00	0.70	0.25	0.32
	10	25,504	996	26	79	250	196	3.90	0.10	0.31	0.98	0.77
	7	3,432	80	0	4	1	0	2.33	0.00	0.12	0.03	0.00
	5	3,028	254	0	2	3	4	8.45	0.00	0.66	0.99	0.13
	3	1,632	109	0	16	0	12	6.70	0.00	0.98	0.00	0.74
	50	240	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00
	15	8,060	395	0	12	31	43	4.90	0.00	0.15	0.38	0.53
	10	12,093	303	7	31	89	70	2.52	0.06	0.26	0.73	0.58
	7	3,414	152	3	38	5	7	4.43	0.09	1.14	0.15	0.20
	5	5,003	264	6	86	2	30	5.40	0.12	1.70	0.14	0.60
5	50	948	7	0	0	4	0	0.74	0.00	0.00	0.42	0.00
	15	13,218	578	0	65	54	35	4.38	0.00	0.49	0.41	0.26
	10	14,085	296	2	116	55	64	2.10	0.00	0.82	0.39	0.45
	5	3,629	165	6	34	2	21	4.55	0.14	0.94	0.05	0.58
71/2	50	589	4	0	0	1	2	0.68	0.00	0.00	0.17	0.34
	15	6,419	243	3	65	28	28	3.64	0.05	1.00	0.43	0.43
	10	10,185	125	5	61	35	39	1.23	0.05	0.60	0.34	0.38
10	100	1,234	7	0	2	3	9	0.57	0.00	0.16	0.24	0.73
	30	9,145	147	0	31	33	32	1.62	0.00	0.34	0.36	0.35
	15	12,163	159	3	88	52	36	1.30	0.02	0.70	0.42	0.29
	10	2,226	49	4	25	8	20	2.22	0.18	1.13	0.36	0.91
15	100	2,285	8	0	0	6	8	0.35	0.00	0.00	0.22	0.35
	30	11,909	126	1	47	42	27	1.06	0.01	0.39	0.35	0.23
	20	6,343	38	6	15	22	21	0.60	0.01	0.24	0.35	0.33
	15	2,714	40	1	36	2	15	1.48	0.04	1.33	0.07	0.55

*NOTE: Operations due to transformer failures excluded.

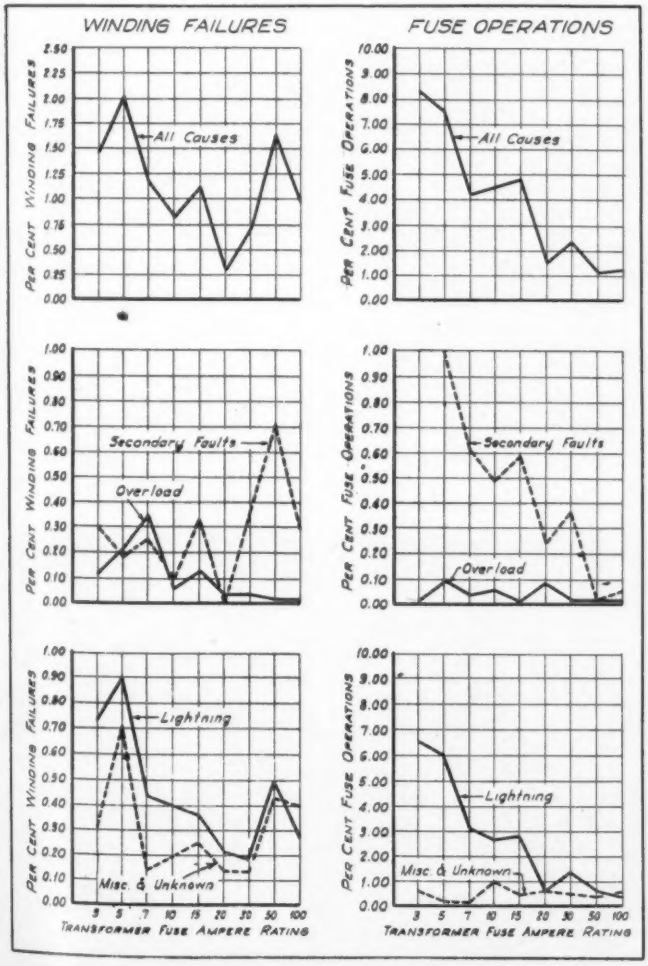


FIG. 1—Winding failures and fuse operations for 222,735 service years of 1½ to 15-kva., 2.4-kv. transformers protected with fuses from 3 to 100-amp. ratings (1942-1944)

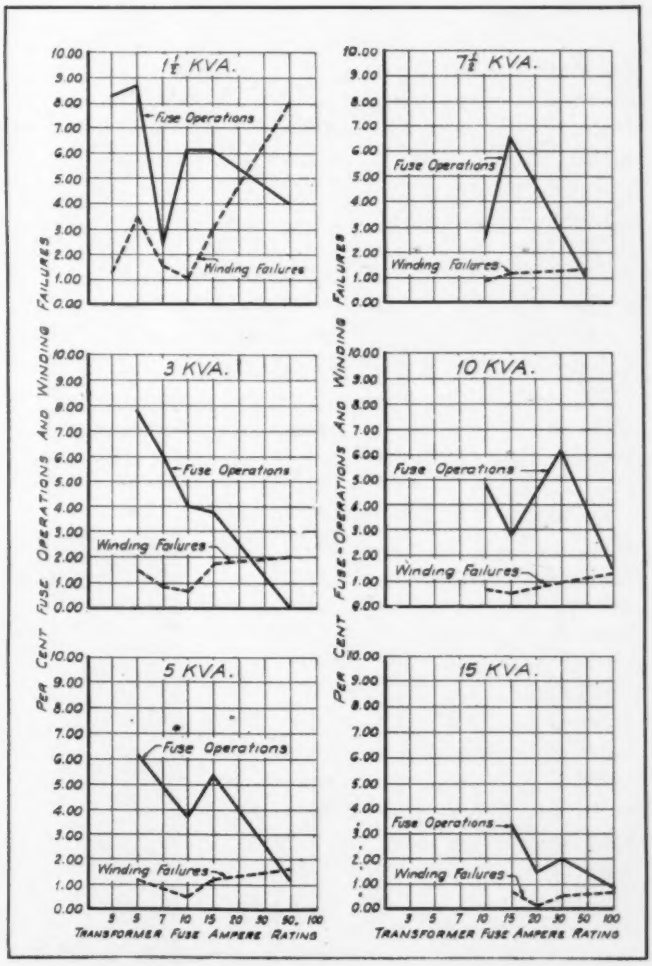


FIG. 2—Winding failures and fuse operations for six transformer sizes from 1½ to 15 kva., 24 kv., in relation to transformer fuse ampere ratings from 3 to 100 amp. (1942-1944)

Simple Design, Reliability Keynote Jennison Station—II

Dual supply for station service—Tubular and square aluminum buses —Isolated phase bus construction between generators and metal-clad switchgear—Electronic control of magnetic couplings—Loudspeaker paging systems for entire plant—Fuel-air ratio control of combustion

W. W. PERRY and WALTER GREACEN, 3rd,* New York State Electric & Gas Corp., Binghamton*

DUE TO WARTIME RESTRICTIONS there are no steam driven auxiliaries in Jennison station except one boiler feed pump. Therefore, a high reliability had to be provided in the electrical supply† for the plant auxiliaries.

A study determined that for the economic use of copper there should be three voltages used for the Westinghouse motors on the auxiliaries:—motors 125 to 450 h.p., 2300 volts; motors 5 to 75 h.p., 440 volt; and all motors less than 5 h.p., 208 volts.

There are two sources of supply for all station service buses, the main source from a 3,000-kva., 3-phase bank of transformers off the 13,800-volt generator bus and the other a 3,000-kva., 3-phase bank off the 46,000-volt transmission system and stepping down to the main and auxiliary 2,300-volt buses. This latter transformer is Y-delta connected and is also utilized as a grounding bank for the 46-kv. system. The neutral of this transformer is carried through a breaker, the operation of which is coordinated with the ground fault neutralizer at the Colliers 114/46-kv. substations. The feed for the 440-volt buses is provided through two 750-kva., 3-phase transformers off the main and auxiliary 2,300-volt buses each feeding the main and auxiliary 440-volt buses. Automatic throwover from the main to auxiliary transformer is provided in case of differential operation on the main bus feeds.

The 208/120-volt bus is supplied through a 300-kva., 3-phase transformer. This latter is a 4-wire system supplying both small motors and lighting loads.

Transformers

All transformers installed are manufactured by General Electric Co. The main power bank is 66,000/114,000-Y to 46,000 delta—13,800 delta with a nominal rating of 30,000 kva. Forced air cooling increases the rating to 40,000 kva. Additional fans can be added to increase rating in future to 50,000 kva. Transformers are nitrogen-gas sealed and cooling fans are thermostatically controlled. Alarms are provided for low oil, low gas pressure, high winding and oil temperatures. A fog nozzle system of Automatic Sprinkler Corp. is installed for fire protection.

The transformers from 13,800/2,300 volts, 2,300/440 volts and 2,300/208/120 volts are all three phase, Pyranol-insulated and located in the basement of the power house. All transformer banks are protected by differential relays.

Switchgear

Switchgear for the 13.8-kv. bus is the Westinghouse cubicle type having compressed air breakers with interrupting capacity of 1,000,000 kva.

The 2,300-volt circuits are provided with Westinghouse Electric metal-clad switchgear containing De-ion air circuit breakers with a rating of 5,000 volts and an interrupting capacity of 100,000 kva.

Main disconnecting contacts are located in horizontal Moldarta tubes mounted behind a shutter sheet. The contacts are silver plated and in the

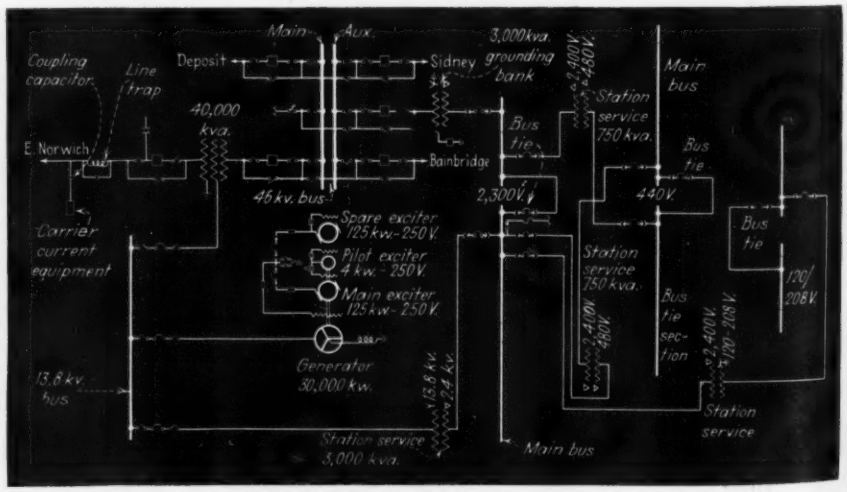


FIG. 1—One line electrical diagram of Jennison Station

* Chief Electrical Engineer and Mechanical Engineer respectively.

† For the steam-end article see ELECTRICAL WORLD, December 8, 1945, Page 118.

engaged position, fingers form a bridging contact between the circuit breaker stud and the stationary contact studs. In this manner considerable flexibility in alignment is obtained without the use of flexible shunts.

Secondary disconnecting contacts for control circuit leads consist of multiple plug and socket contacts of the train-line-coupler type.

Draw-out potential transformers are provided to meet the demand for safety in the removal of potential transformer fuses. The transformers are mounted on a movable truck which is equipped with primary and secondary disconnecting contacts. In the withdrawn position all contacts are disconnected, primary conducting parts of the potential transformer are grounded, safe clearance from live parts of the switchgear is provided, and then transformer fuses may be safely removed. Access to high tension compartments enclosing current transformers, buses and connection is provided by removable, bolted covers.

The switchgear for 440 and 208/120 volts is the Multumite, drawout unit type manufactured by I.T.E. Circuit Breaker Co. The rating of the air circuit breaker on a standard 0-2 minute CO duty cycle is 25,000 amp. on the 440 volt and 25,000 amp. on the 208/120 volt. The drawout circuit breakers are mounted on pantograph mechanisms which hold the breaker in a vertical position during connecting and disconnecting. The drawout mechanism is operated by a screw provided with a removable crank handle. When fully withdrawn the breaker may be lifted off the pantograph frame.

Bus Enclosures

The bus between 13.8-kv. generator leads, power transformers and auxiliary transformers is of isolated phase construction. It is designed for 2,000 amp. between generator and power transformers and 1,200 amp. for station service transformers and for short circuit stress of 1,000,000 kva. in each instance.

Isolated phase construction has the bus entirely encased in its own separate metal housing; housings of adjacent phases are separated by an insulating air gap.

Enclosure is made of 0.102-in. thick 2-S half-hard aluminum sheet rolled to form a circular housing 17-in. inside diameter with formed edges. The housing enclosure is clamped to the cast aluminum supporting rings and one end is insulated (electrically) from the supporting rings by a thin fibre strip. This minimizes the sheath currents and permits the use of unventilated type enclosure.

Bus conductor is $3\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{3}{8}$-in. square aluminum tube supported in the supporting ring by four insulators, so arranged that they are subjected only to compressive stresses.

Bus joints are copper, cadmium-plated to eliminate the galvanic action between copper and aluminum. Bus joints are made in three types—either solid, expansion or flexible, each type used required by the design of the structure. Joints are bolted to the aluminum conductors with a $\frac{5}{8}$-in. high tension steel bolt with Belleville spring washer to maintain a constant contact pressure.

Porcelain Pivots

Porcelain insulators are constructed with a sleeve in one end and a saddle at the other end. The sleeve fits over the adjusting stud, and they are shaped so as to permit the insulator to pivot through a short arc about a center located at the outer end of the insulator. The saddle at the other end has a convex surface which fits against the corner of the conductor. Such construction allows a small longitudinal movement of the conductor without setting up objectionable side stresses in the porcelain.

The adjusting stud which fits into the porcelain sleeve is threaded at one

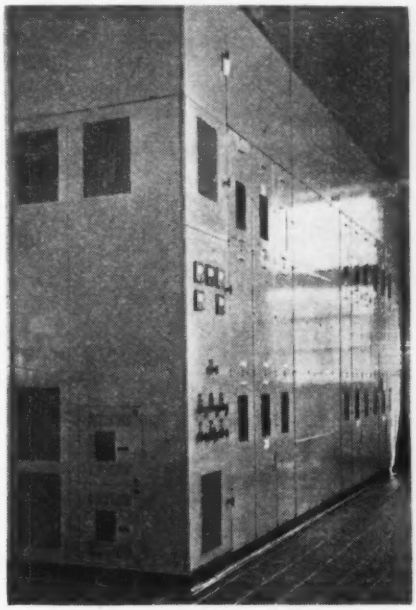


FIG. 2—13.8-kv. metal-clad switchgear with compressed-air circuit breakers of 1,000,000 kva. interrupting capacity

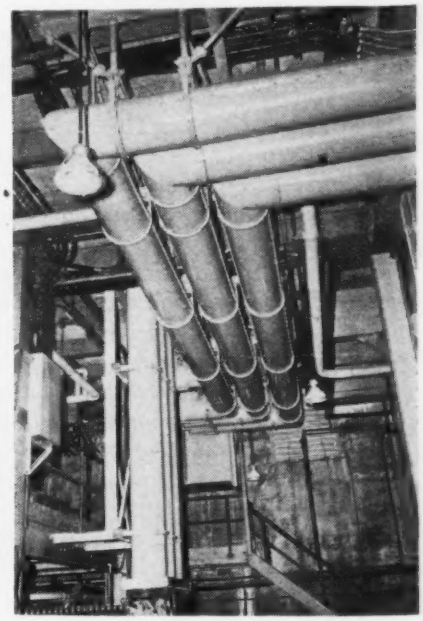
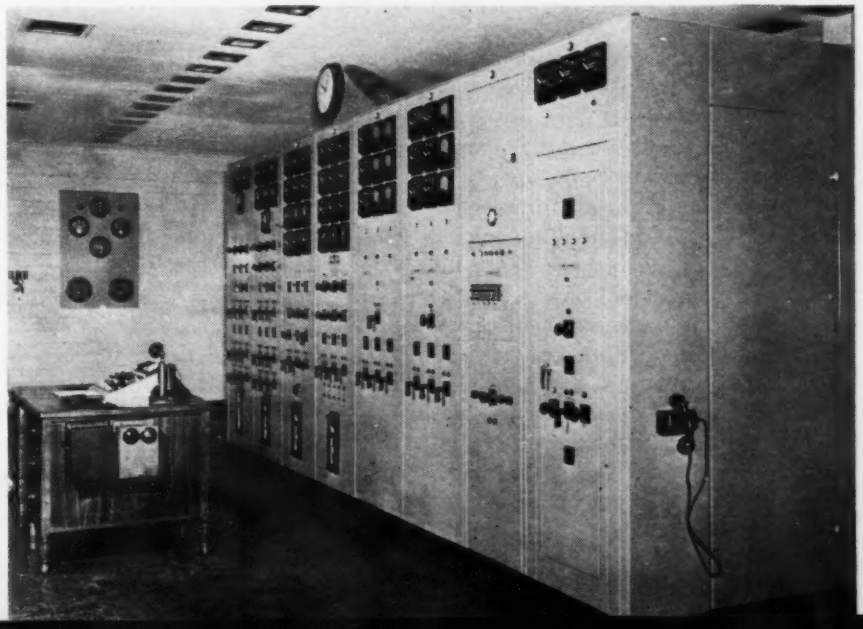


FIG. 3—Isolated phase bus construction employed between generator terminals and metal-clad switchgear

FIG. 4—Tunnel type construction for main control board. The synchroscope, steam gage and frequency meter are on side wall



end. This provides adjustment of the stud position in the supporting ring, thereby furnishing an easy method of controlling the pressure on the porcelain, and provides adjustment for the conductor.

Supporting rings are aluminum alloy castings, heat treated, with a minimum tensile strength of 30,000 lbs. The rings are so designed as to give maximum strength where required and arranged for bolting to an H-beam. All are grounded by means of a flat copper bus which is installed on the H-beam under the mounting feet of the supporting rings. This ground bus is tied to the building ground system.

Protective Features

The 440- and 2,300-volt motors are all protected with induction overcurrent relays for locked rotor current. Instantaneous elements provide fast clearing of faults. Thermal overload relays give an alarm at the turbine and boiler operating boards.

All transformers, buses and main generators are protected by differential relays. Differential relay operation of the main station service transformers will automatically provide service from the auxiliary source.

There are four annunciator alarm systems which inform operating personnel immediately of impending equipment failure or any abnoral operating conditions. This system provides a signal light and audible alarm with provisions to silence the alarm, the light remaining until trouble is cleared.

(1) Main switchboard control room.

This annunciator system covers alarms on all transformers, main supply circuit breakers, 44-kv. and 114-kv. transmission lines.

(2) Boiler board on main operating floor.

This system provides boiler operator with alarms on all boilers and auxiliary equipment.

(3) Turbine board on main operating floor.

This system provides turbine operator with alarms on associated equipment for the turbine generator unit. This includes alarms on the oil seals and hydrogen control equipment for the hydrogen cooled generator.

(4) Pump board on basement floor.

The main portion of the plant auxiliaries are located in the basement and alarms are centralized in a pump operating room. Several steam, water and air gauges are located in the pump operators' room.

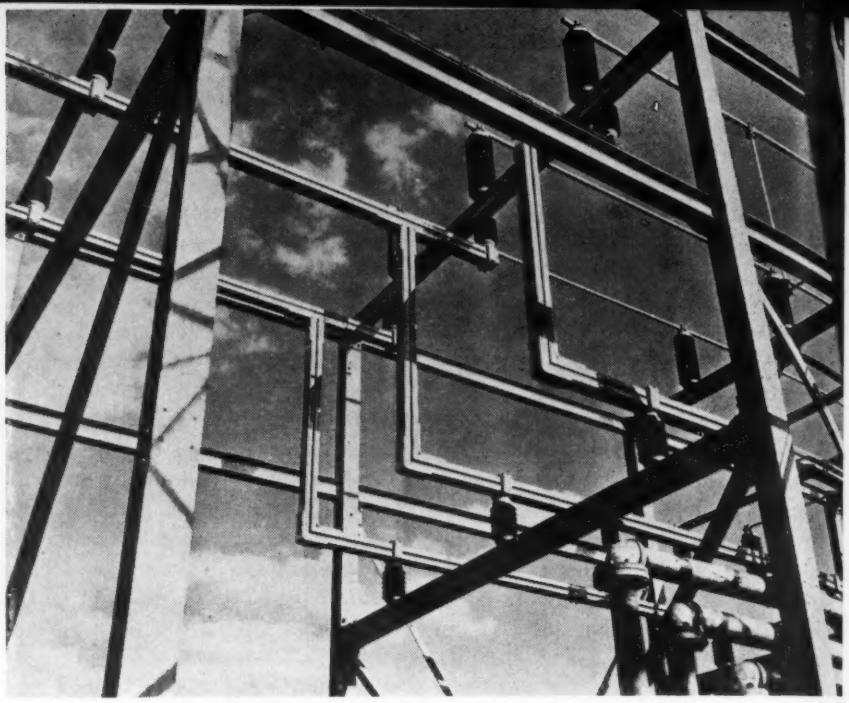


FIG. 5—Outdoor section of 13.8-kv. bus of 4-in. aluminum channel

Excitation

The excitation is supplied by a direct connected 125-kw., 250-volt generator and a 4-kw., 250-volt pilot exciter. These are of the latest design and many improvements will make a more reliable 3,600 rpm. excitation system.

New ventilation arrangement has many advantages. Room air is drawn in through filters in the base by a fan on the exciter shaft, and enters the exciter chamber under about 2-in. water-column pressure. This puts a positive pressure around the bearings and eliminates the possibility of oil vapor mixing with the ventilating air. Cool air is supplied to both ends of the main exciter armature and discharged at the bottom of the stator between the armature and commutator, thus eliminating the danger of carbon dust collecting on stator or rotor windings. Cool air to the pilot exciter passes over the field coils and rotor and is discharged over the commutator and out to the room, keeping carbon dust out of the pilot exciter also.

Dynamatic Variable Speed Drive

Variable speed drive for the 450 h.p. induced draft fan motors is furnished by the use of a magnetic clutch, built by the Dynamatic Corp. The speed range of this device is from 0 to 570 rpm., and is speed controlled by electronic control equipment. The same system is used for the traveling grate type stokers, only using 7½ h.p. adjust-speed clutch and motor unit.

Current required for excitation is very small, approximately 1/10 of 1 percent of the mechanical power handled, thereby making electronic control feasible. The speed control potentiometer is operated by a Leeds and Northrup fuel-air ratio device, which ultimately determines the fan running speed. The electronic control consists mainly of four units: (1) the grid control gaseous rectifier system which furnishes power for the clutch coil, (2) the speed discriminator system which actuates the power rectifier tubes with reference to speed, (3) the speed control potentiometer capable of giving ten thousand individual speed settings, being actuated by the Leeds and Northrup operator, (4) an a.c. governor generator which very accurately produces a voltage proportional to the fan running speed.

Electronic Control Reliability

Inherent reliability of this control system is very good, due to the tube back-up protection provided through the use of two tubes for each single tube function. A duplicate emergency electronic control was also furnished with an automatic and manual transfer system which is used in case of trouble or routine maintenance without shutdown.

Tests have shown that the speed control of the entire mechanical and

electrical system is excellent, holding any set speed through the entire operating range from 0 to 570 rpm. with an accuracy of approximately 1/10 of 1 percent over long periods of time. Quick response and instantaneous follow-up without overshoot or hunting is an inherent characteristic of this method of control.

Main Control Board

Main control for both generating plant and associated substations is located in a control room on the mezzanine floor overlooking the main operating floor. Tunnel type construction of the board provides adequate facilities for the control of the generator, main and auxiliary transformers, and 44-kv. and 114-kv. transmission lines. Each panel incorporates various indicating lights to provide alarms on their associated equipment, such as low air, low oil, high temperature, etc. In addition to the alarm light an audible signal is provided which may be silenced by a reset button and a panel signal light provided at the top of each panel to give the operator a quick indication of the source of trouble.

A synchronizing panel is flush mounted in the end wall of the control room and provides synchronizing facilities for all circuits. A steam pressure gauge is also installed at this point to provide the switchboard operator with information regarding the status of the boilers.

An automatic oscillograph is located in a room adjacent to the control room with facilities for developing the oscillograms. Facilities are provided at the rear of each panel for connecting this oscillograph to any one of the several points for study.

46-kv. Substation

This substation is a galvanized steel structure containing oil circuit breakers, airbreak switches and a double bus. This station provides switching facilities for the main 46-kv. power, three outgoing transmission circuits, a combination grounding bank and emergency station service supply, and bus potentials. The 46-kv. breakers are rated at 1,200 amp., 1,000,000 kva. interrupting capacity with pneumatically operated mechanism. Switching facilities are provided to transfer any of these circuits to either the main or transfer bus and to bypass the oil circuit breaker. Key interlocking is provided between the breakers and their associated switches to prevent improper sequence.

Main buses, taps and connections consist of aluminum tubing and cable, and all connections are made with high strength aluminum connectors and bolts.

Transformer Structure

Transformer structure of galvanized steel is located adjacent to the power plant and provides bus facilities for the main transformer and the one outgoing 114-kv. transmission circuit.

The 13.8-kv. bus from the generating plant wall to the terminals of the main transformer is constructed of two 4-in. aluminum channels placed face to face in a horizontal position. In addition to having sufficient current carrying capacity, the design provides mechanical strength for short circuit stress. Taps to this bus are made with $\frac{3}{16}$ x 4-in. aluminum bars to provide expansion between buses and transformers.

The 114-kv. neutral bus is constructed of aluminum tubing with provisions on the neutral bus for the installation of future switching.

The 46-kv. and 114-kv. substation structures are completely shielded with overhead ground wires for lightning protection. All transmission lines from the substations have overhead ground wires installed.

The 115-kv. oil circuit breaker is rated 600 amp., 1,500,000 kva. interrupting capacity with pneumatic operating mechanism. This breaker is also provided with key interlock with its associated switches to prevent improper operating sequence.

Paging Systems

Two complete RCA Paging Systems are provided to give complete coverage for the operation of this plant. One system covers the coal handling from the track hopper house through the tunnel to the bunker room floor in the top of the plant. It is entirely separate from the main plant paging system, having microphones and loud speakers located at proper points with a separate power amplifier.

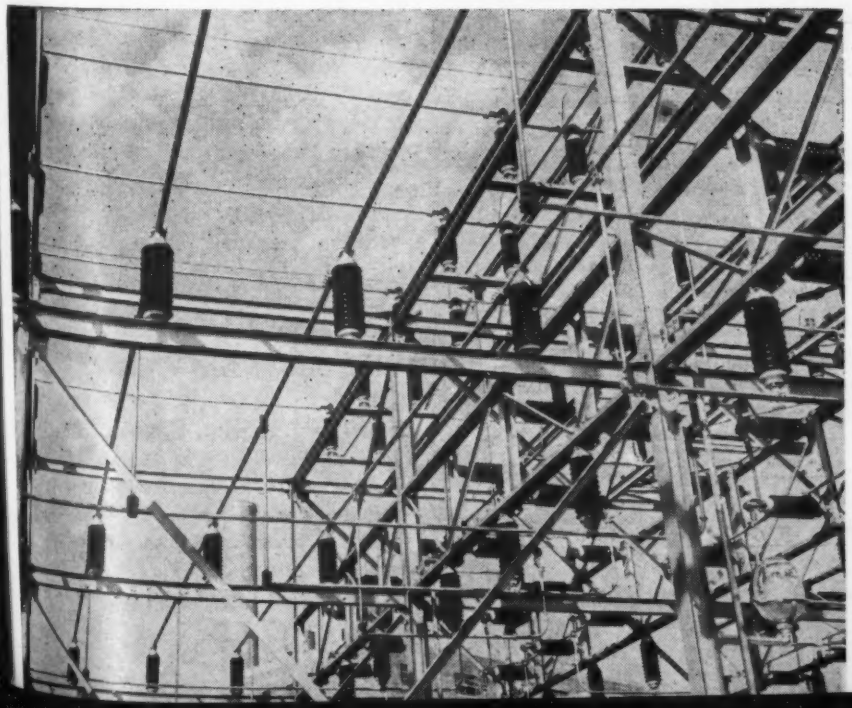
The main plant paging system covers the rest of the plant with a sufficient number of power amplifiers to provide proper operation in a case of failure of one amplifier.

Various types of loud speakers are used, depending on the conditions involved, to provide complete coverage of the plant, including offices, locker room, machine shop, etc.

Microphones are installed at all operating points and offices to facilitate transmittal of operation instructions and for convenience in locating personnel. These microphones are of the telephone hand-set type, and incorporate both speaking and hearing facilities. The hook switch on which the hand set is mounted cuts out the adjacent speaker if this is felt to develop a feed-back, and operates a plate relay in the power amplifiers which leaves the power amplifiers in the inoperative position when not in use.

Test facilities are installed at the location of the power amplifiers to provide facilities for testing the power amplifiers periodically, in order to maintain high quality service.

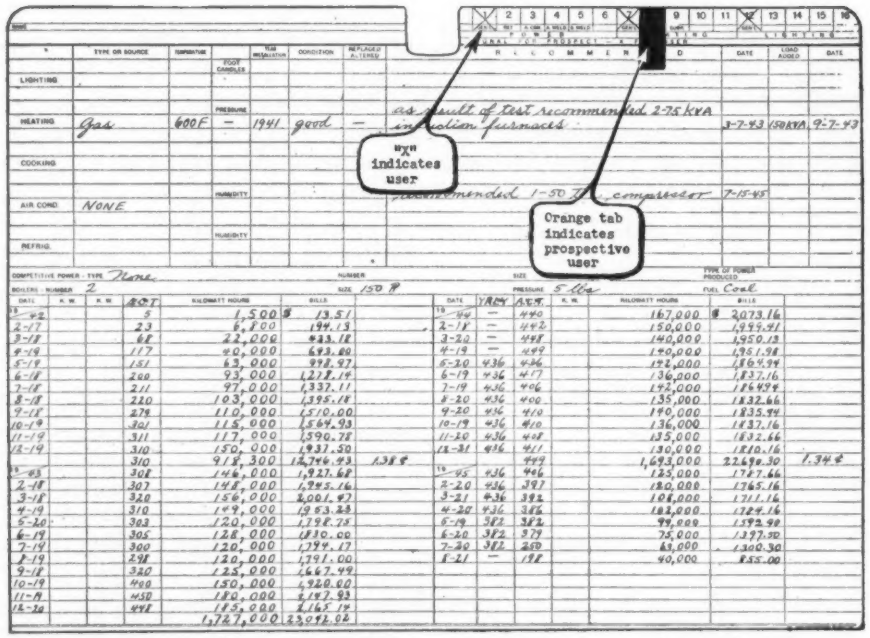
FIG. 6—46-kv. substation has aluminum tubular bus and station post insulators

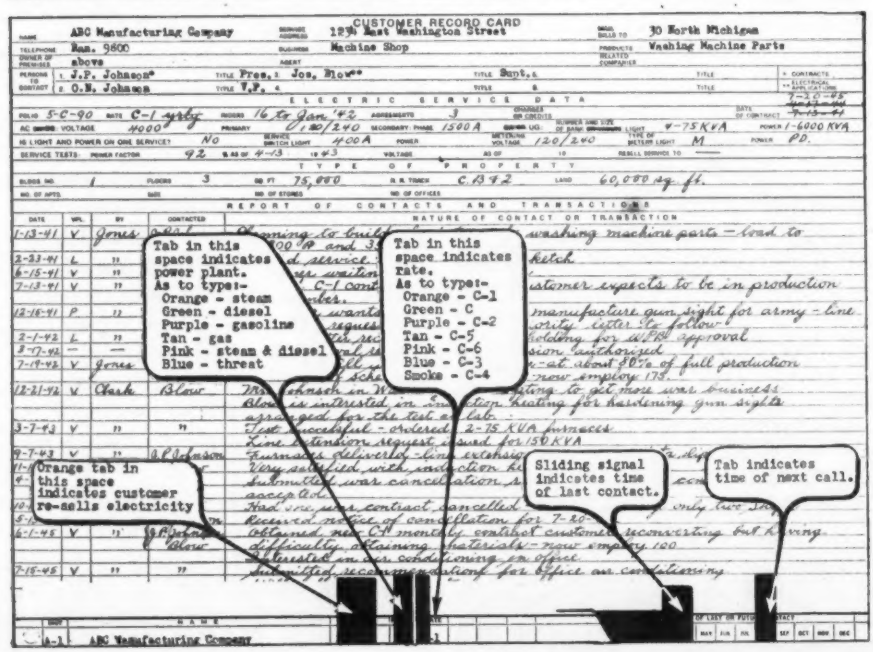


Adequate Customer Records An Aid to Sales Management

Newly instituted records system for large light and power customers, provides salesmen and supervisors with visual summary of customer contact frequency, and complete and rapid review of service data, history of transactions, type of service, past use and similar data

FRANK M. GEDDES,* Electricity Sales Dept., Commonwealth Edison Co., Chicago, Ill.




Tab in this space indicates power plant. As to type:- Orange - steam Green - diesel Purple - gasoline Tan - gas Pink - steam & diesel Blue - threat
Tab in this space indicates rate. As to type:- Orange - C-1 Green - C Purple - C-2 Tan - C-5 Pink - C-6 Blue - C-3 Smoke - C-4
Orange tab in this space indicates customer re-sells electricity
Sliding signal indicates time of last contact.
Tab indicates time of next call.

KEEPING of adequate customer records is a phase of sales direction often overlooked by sales managers who feel that it is a routine matter that isn't important and doesn't merit much attention. Perhaps this feeling is partially justified. A good customer record system is like good health: you don't realize its importance as long as you have it; but if you don't have it, the deficiency becomes a major handicap.

Efficient performance of sales personnel is of primary importance at all times if sales organizations are to adapt themselves to rapidly changing conditions. Any instrument that can contribute economically to the effectiveness of such an organization should be utilized. A good customer record system is such an instrument —and not the least important one, since sales direction and sales performance are largely contingent upon adequate records.

Primary Objectives

In setting up our customer record system for large light and power customers we sought to achieve the following primary objectives:

1. Establish a complete, accurate, flexible, and readily available record of customers assigned to each sales representative.

2. Consolidate customer informa-

* Supervisor, General Office.

CUSTOMER RECORD CARD used by Chicago company contains complete information on service facilities, existing and potential power applications in form for rapid review. Both sides of card are shown

tion available from many sources into one central file and so provide fundamental data regarding customers to aid sales representatives in expediting service and in knowing customer's personnel, their premises, and their present and prospective uses of electricity.

3. Record the history of transactions between the company and its customers.

4. Standardize and simplify the handling and recording of customer contacts.

5. Aid in training new personnel by having the facts and experience of the department recorded and readily available.

6. Serve as a basis of supervision, control and direction.

7. Provide a constant source of valuable information for management and employees and permit special analyses to be made promptly and effectively.

Has Three Parts

Workings of the system were simplified as much as was practicable. Basically the system is comprised of only three parts: (1.) Contact reports, correspondence, contracts and related papers for which the sales representative is (and must be) responsible; (2.) Customer record card file of the visual type which is maintained by a file clerk and contains a summary of customer information; and (3.) Customer file which is also maintained by a clerk and which contains the details of all transactions.

For each customer contact the sales representative prepares a written contact report, its length dependent upon the complexity and importance of the subject. These reports, together with all material relating to customers, are routed through a clerk who abstracts the detailed information and posts it on the customer record cards. The detailed information is routed to and filed in a correspondence-type file.

As can be seen from the illustration, the visual tabs, signals and color codes used with the file enable the sales representative to review his relations with customers at any time. In a matter of minutes, he can ascertain what accounts he has not recently contacted, what accounts should be followed up, which customers are prospects and what their status is, and which customers may require a change of rate; or he may review the past several years transactions for any particular customers.

Similarly the customer record card file provides an equally effective means of supervision. The sales supervisor can in a few hours each month review with the sales representative the latter's assigned customers. Easily ascertained are such facts as what coverage the sales representative is obtaining; what negotiations are in progress with each customer; what men in customers' organizations the representative is contacting; how much is known about each customer and his premises; what the current prospects are; how they are being handled, and how often they are followed up; what prospects actually have been sold; in short, practically all the aspects of the sales representatives work can be covered. In this way the supervisor can select the difficult customers and give help either personally or with specialized engineering talent, to insure successful consummation of transactions.

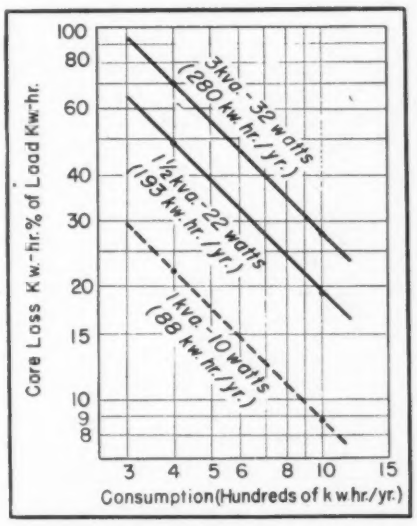
Collateral benefits include the simplification of contact recording and summarizing of customer contacts; ease of analyzing districts by rate, type of business, and number of accounts; quick identification of users of certain types of equipment; correlation of load added to increased revenue; and other similar data.

It is estimated that the cost of maintaining this customer record card file approximates $1 per year per account or less than 0.01 of 1 percent of the annual revenue which the average represents.

• • •

Smaller Rural Transformer Advantages

FRED T. BEAR
Electrical Engineer, Delaware Power & Light Co., Wilmington, Delaware



TRANSFORMER CORE losses high proportionately for low-use customers

A single customer without an electric range or water heater will have a maximum demand of about 1,200 watts (1,000-watt electric iron plus 200 watts light, radio, etc.) and annual consumption of 300 to 1,200 kw.-hr. Wide range of kw.-hr. in this class is caused by presence or absence of refrigerators and water pumps, each of which will use 300-500 kw.-hr. per year, with little increase in demand. Average consumption of a group of non-range customers will probably lie between 600 and 900 kw.-hr. per year, depending on saturation of refrigerators and water pumps.

The accompanying graph indicates rather startling loss percentages, where only one customer is supplied by a transformer. At 600 kw.-hr. per year the core loss amounts to 32 percent on a 1½ kva. and 47 percent on a 3 kva. At 900 kw.-hr. these values are 22 and 31 percent. The 3 kva. is cited only because it has occasionally been proposed to make this the smallest size distribution transformer.

It appears that it would be desirable to replace the 1½-kva. rating with a new size which should have a normal rating of about 1 kva. and core loss of approximately 1 percent (10 watts). This percentage would correspond with that now in use on 3 kva. The broken line represent loss percentages with this design, indicating that they would be reduced to 15 percent for 600 kw.-hr. and 10 percent for 900 kw.-hr.

Load losses are not important because of the extremely low load factor, and are restricted by need to limit voltage drop percentage, rather than to limit losses. For example, with 876 kw.-hr. per year at 1½-kw. peak, load loss on a 1½-kva. transformer is only about 1 percent in contrast to core loss of 22 percent.

Electronic Applications Extensive Among Utilities

Committee survey by PEA reveals 124 different applications by ten companies—As many as 44 in a single company—Instances of 25 years of use of Kenotrons and 23 years of carrier relaying

H. N. EKVALL,†
Pennsylvania Electric Association

A JOINT INVESTIGATION was conducted by the Communications Committee and Electrical Equipment Committee of the Pennsylvania Electric Association on the application of electronic equipment used in operation of the power industry. A condensed summary of the joint sub-committee report on this investigation is presented herewith.

This report is based on information received from ten electric utility companies in Pennsylvania and neighboring states. A summary of the data reported is given in the table, showing the type of application of elec-

† Chairman, Joint Sub-Committee on Electronic Developments.

P. E. A. SUMMARY . . . (Figures in table represent years in use among the ten companies contributing to the survey)

	A	B	C	D	E	F	G	H	I	J
GROUP 1—Control and Regulation										
Carrier Control, Air Switches, O. C. B., Etc.	4			11		2	5	10		6
Electronic Circuit Breaker Control				9	6					
Coal Pulverizing Mill Level Control		4								
Photo-electric Street Light Control				8		10	6	4	7	
Magnetic Clutch Control—Draft Fans					2					
Constant Voltage Regulator for Battery Charging		7		10	6					7
Constant Voltage Regulator for Meter Calibration		16								4
Turbo-generator Voltage Regulator										2
Synchronous Condenser Voltage Regulator										3
Carrier Street Light Control								4		
GROUP 2—Communications										
Carrier Telephone	15	20	20	22		2	2	23		
Carrier Call System	5									
Loud Speaker Two-Way Tel. Com				3	7		2	3		6
Speech Amplifier for Time Announcement					16					
Radio Telephone or Telegraph					2	10	5	20		
Telephone Line Amplifier	4	5		3						
GROUP 3—Relaying										
Carrier Relaying	4	6	1	4		3		7		
GROUP 4—Rectification										
Battery Charging (12 Volts and Less)		11	15	2	15	10	15	15	10	
Tele. Battery Trickle—Charge Ges-Diode 130 V					15				14	
Tel. Battery Mercury Arc 50 Amp., 24 V					20				15	
Subway Trains—2200 Kw., 650 V. Mercury Arc						3				
Bldg. Elevators—550 Kw., 650 V. Mercury Arc						4				
Electric Buses—1400 Kw., 600 V. Mercury Arc						3				
Street Railway—4-500 Kw., 600 V. Rectifiers					17					
Street Lighting—6.6 Amp., 6750 V					19					
Mine Power—500 Kw. Ignitron	5									
Mine Power—2-300 Kw., 275 V., 6 Phase					3					
Power for Coal Washing Screen	1	4								
Generator Field Control					6					
Surge Generator Charger				1	12					
Arc Welder (60 Amp.)					4					
Kenotron for Testing						16	25			
Phano Chargers—125 V., 12.5 A				2		3				
General Testing Rectifier—700 V., 150 Mils						5				
5000 V.—D. C. Rectifier						5				
GROUP 5—Alarms and Indicators										
Air Raid Alarm Signal Timer										24
Vibration Intrusion Alarm	2									
Photo-electric Intrusion Alarm						2	3			
Smoke Detector Alarm						3				
Carrier Sleet Detector Alarm		2								
Experimental Oil Level Alarm					*					
Bus Leakage—Current Alarm						6				
Hydrogen Purity and Pressure Alarm						3				
Boiler Temperature Indicator					2					
Carrier Signal from Unattended Substations	2									
Mercury Boiler Vapor Detector						10				
Indicating Frequency Meter		*								
Statiscope							10			
Vibration Indicator					5					
Voltage Surge Indicator										4
Overhead Control Cable Grounding Device										44
Change in Impedence Detector (Pilot Wire)										2
Boiler Flame Loss Alarm										4
GROUP 6—Measurements, Metering and Recording										
Telemetering Inverter										7

	A	B	C	D	E	F	G	H	I	J
Carrier Telemetering	7									
Wire Telemetering for Load Control		10			1		2			9
Wire Telemetering—Impulse Type Receiver					1					
Smoke Density—2 Photovoltaic Cells—Changes Grid V					10					
Smoke Density—Photo Tube used as Variable Resistor					4					
Smoke Density—Photo Tube used in A. C. System					14					
Boiler Temperature Recorder					2					
Wave Analyzer	4					5				
Vacuum Tube Voltmeter	3	6				1			2	
Radio Noise Meter	4					5		13	4	10
Cathode Ray Oscilloscope	4	8		12	6	8	4	*	8	
Capacity Bridge	3	4			3				6	
Megohm Bridge	3			7						
High Speed Frequency Recorder		4			4					
High Speed Voltage Recorder		3								
Surge Crest Ammeter										½
Sound Analyzer										5
Electrometric Titrimeter									1	
Stroboscope		10			4					
Daylight Intensity Recorder					4					
Vibration Recorder—Turbine Bearings							3			2
pH Recorder					2					1
Speed Recorder—Turbine						4				
O_2 Gas Analyzer—Boilers							3			
Eccentricity Recorder—Turbine							3			
Expansion Recorder—Turbine Shell							3			
Speed and Cam Shaft Position—Turbine							3			4
Sound Level Meter						8		7		5
GROUP 7—Testing										
Carrier Current Testing Generator	3			10						
Carrier Signal Tracer	3									
Carrier and Telephone Loss Test Set	2									
Portable Audio Frequency Oscillator		12		7					7	
Oscillograph for Wave Shape Analysis, Etc					12			6		
Watthour Meter Photo-electric Rev. Counter				2	4	3	10			20
Watthour Meter Automatic Tester—All Loads							2			
Insulation or Oil Power Factor Tester					7	5				
Kenotron Cable Tester—Fixed						16	25			
Kenotron Cable Tester—Mobile						8				
Frequency Standard						1				
Tube Tester (Emission Type) Field				3		3			9	
Tube Tester (Transconductance) Lab						½				
Rider Chanalyst									6	
Surge Generator for Arrester Testing				1		*				
GROUP 8—Fault Locating										
Standing Wave Transmission Line Faults		10								
Motor Timed Impulse Fault Locator—5 to 10 Kv					8					
Motor Timed Impulse Fault Locator—1.25 to 2.5 Kv					8					
Breakdown Voltage Tester—100 Kv					1/3					
Breakdown Voltage Tester—20 Kv					1/3					
Tone Amplifier for Telephone Cables					1/3					
Full Wave Rectifier Fault Locating Tester					7					
Kenotron Cable Tester						16	25			
Audio Amplifier Cable Fault Locator						5	4	5		
Surge Discharge Fault Locator							½			
GROUP 9—Miscellaneous										
Radio Receiver Time Signals	8	12			5	10		20	14	
All Wave Receiver—Radio Interference Locator	6	8		5		15		20		
Vibrator Power Supplies for Vibrator Tools				10					17	
Recorder Amplifier and Playback	3				5					
Sound System for Announcements, Etc					2	1/3	8			
Locator of Buried Pipe, Cables, Etc		12		6			5	8	8	3
Fluorescent Lighting in Stations							4		3	
Neon Pilot Lights							10		10	
Fly Ash Precipitator							10			
Precipitron Air Filter										2
10 Million Megohm Ohmmeter						5				
Water Resistance Test Set						20				
Ground Test Bridge						20				
Amplifier						20				
Voltage Dip Device						3				
A. C. Network Analyzer						6				
Electronic Timer						5				

tronic equipment and years in use by each of the ten companies. An analysis of this table discloses the following salient points:

1. A total of 124 diverse applications of electronic equipment were reported in use by the ten power companies covered by this survey.

2. These applications were classified into nine principal groups according to their general operating function. Group 6, Measurements, Metering and Recording, had the largest number of applications, a total of 29.

3. The number of applications in use by each of the companies ranged from 3 to 44.

4. None of the 124 applications was reported in use by all ten companies.

5. The most widely accepted applications involved carrier control, carrier telephone, carrier relaying, battery charging, cathode ray oscilloscope, radio time signal receiver and locator for buried pipe, etc., equipment. These are the only applications in use by over half of the companies.

6. Electronic equipment usage by the ten companies covers a period of 25 years with the oldest application being the Kenotron. About half of the applications may be considered new, with five years or less in service, while about 80 percent have only ten years or less in service.

It is believed that this report will be found of particular value to the individual power companies by way of comparison with others in showing their relative progress in the use of electronic equipment. In this way, interest may be stimulated particularly in the newer developments and wider use encouraged.

*Note: Time in Service Not Reported

Editorials

S. B. WILLIAMS, *Editor*

FPC Policy on River Development

IN THE POLICY of the Federal Power Commission on river development, as announced recently by the then acting chairman, and now chairman, power is not something incidental but of correlative importance with irrigation. This statement of policy made before the California Water Conference early in December, while recognizing the prior importance of irrigation, flood control and navigation, takes the position that a balanced regional economy cannot reach its full development without wide use of power at the lowest possible cost.

It is not clear from reading the statement whether power cost is to be based on sound accounting or whether it is to be based upon the contributing benefits that might come to a region by virtue of industries that could be attracted to the region by the low power costs. As developed at the Sacramento meeting, one got the impression that the government might well afford to balance its multi-purpose project books on the basis of over-all regional economic benefits rather than a return on its investment.

It was pointed out, for instance, that every 75,000 kw. of new power capacity might be expected to bring about the investment of about $50,000,000 in new industrial plants, providing direct employment for some 7,500 additional workers which would mean support for an additional population of about 40,000.

These figures might take a lot of proving, particularly if one used a multiplier of even, say, 20. There is some doubt in our mind, for instance, that a million and a half kilowatts of new power would bring close to a million of new population to a region. However, the thing that FPC fails to understand is that power has to be sold, for the chairman said that "low cost power in abundance will create its own market." That isn't so.

Power is such a small part of the cost of production of most manufactured products that low cost of itself is seldom a controlling factor. Other government project managements have found this out and some of them are struggling mightily right now to find markets for their surplus.

Certainly, power should be given full consideration in planning any multi-purpose project but it should be made to stand on its own two feet. If it is dependable power, it can be sold and those who buy it should not be subsidized in competition with tax-paying industries elsewhere. Nor is it necessary to pay subsidies if the government is willing to offer the power through channels that can dispose of it in the best markets.

To do this, however, we cannot confine the markets to small areas. The Commission agrees with this. It is far better to bring the power to the market than to try to bring the market to power.

America stands second to no other nation in terms of power development. America produced overwhelmingly in the war because it had more power behind the worker and always enough and more. This was done very largely by private power and what it has done it can again do. This is a job that requires experts. Government working with them might achieve its objectives more quickly and at less charge to the public debt.

An Industry Sales Training Program

CONGRATULATIONS to the Edison Electric Institute and the National Electrical Wholesalers Association for jointly working out and sponsoring a sales training program for the electrical industry which virtually everyone who has seen it commends highly.

If there is one lesson this country has learned it is that high levels of employment can be maintained only so long as sales are high. We know we can produce the goods; the war taught us that. We must learn how to move that production at a rate from one and a half to two times as much as pre-war.

Not only will selling post-war take a lot of salesmen but since their job is to move so much more volume, they must be better salesmen. They must be well trained.

This program which employs the training techniques so successfully used by the armed services during the war can be used to train salesmen not only for utilities and for wholesalers but for manufacturers, dealers and contractors as well. If by good fortune the whole industry could be induced to use the same training program the benefits would be even greater.

One of the appealing things about the course is that it isn't all just "listen" on the part of the trainee. Of course, there is plenty of that but in between he is given practical assignments to work out himself which, when completed satisfactorily, give him the tools to back up the techniques he has been taught.

Another worth-while point to which we wish to direct attention is the co-sponsorship of the utility and the wholesaler national associations. Both industries have their own individual problems but in addition they realize the importance of strong dealer and contractor sales. Obviously, the better sales job these customer-contact groups do, the better the load growth and merchandise turnover. Neither the utilities nor the wholesalers can of themselves do more than a small percentage of the whole selling job. If the industry is to do its part in providing employment, there must be many sales outlets whose com-

bined volume accounts for the largest part of the total. Obviously, it's just good common sense to help them with good sales training.

All of which gives us even greater conviction that we can relight America in the next decade and double residential usage by 1950.

How Not to Encourage Farm Electrification

THIS MAY BE an isolated example and by no means general, but it struck us as an excellent way how not to encourage rural electrification. An owner of a small farm, after waiting until war restrictions were removed, succeeded in having service extended to his place and shortly thereafter was amazed to find that his taxes were doubled. Upon inquiry he learned that this was regular practice in his section. In his particular case what it amounts to is that electric service costs him about five dollars a month more than is shown on his bill.

Of course, electricity on a farm makes it more salable and enhances its value, but hardly enough to warrant a doubling of the taxes. It is a doubtful compliment to the value of electric service to have the customer wonder if perhaps he hadn't been a bit hasty in putting it in.

What NEMA Will Do in 1946

WHILE most associations take time at their annual meetings to tell the members what was accomplished during the previous twelve months, the National Electrical Manufacturers Association reverses the process and, instead of reciting what was done, tells what it intends to do. It is this program that the members pay for and so it forms the basis of the next year's budget.

"What NEMA Will Do in 1946," released last week, shows a budget totaling $700,000, nearly 50 percent more than was spent in 1945.

Largest of the nine groups into which more than 60 projects are classified is business development, which absorbs more than a quarter of the total. However, although nearly $200,000 is allocated to this group, only six projects are covered in the totals. In addition, there are six more which are financed directly by the sections involved without any allocation from the rest of the membership dues.

With budgeted expenditures for business development more than doubled, most of the increase comes from a new project for developing the rural and suburban markets. If to it is added the budget for farm electrification, which was trebled, it is found that NEMA will spend more on rural development than anything else, although adequate wiring is running a close second.

Interestingly enough, NEMA is boosting its expenditures for market development at a time when the demand exceeds the supply. What is the reason? Simply that these are long-range programs aimed at an orderly development of the market. Such programs can never be evaluated in terms of the accomplishments in the initial years. There comes a time, however, when the accumulation of past efforts begins to bear fruit.

Adequate wiring promotion, for example, started small but kept going even during the war. Today it has more people in other branches of the industry actively promoting the program than ever, with the result that when new house construction opens up it will be found that adequate wiring has a much greater acceptance. Likewise, to the Street and Traffic Safety Lighting Programs can be attributed most of the credit for reviving industry and public interest in better street lighting. For the first time since the old white-way days, the demand for modern lighting on streets is humming.

Another interesting feature of the NEMA program is that it does not try to do the whole job itself. Fundamentally, the business development projects are aimed at arousing the self interest of the entire electrical industry. Such programs are perhaps not as spectacular as those based on large advertising expenditures but in the long run they are very effective. In fact, these modest stimulating or pump-priming programs enable NEMA to engage in a great many projects at the same time, which would be impossible if single projects ran into hundreds of thousands or millions.

Basically, the philosophy of NEMA is that the member companies are interdependent and each benefits more or less in these development programs. Therefore, they contribute to the different projects to the degree of their beneficial interest and allocations are made on that basis. Thus each member can bear a share of the cost of several programs without feeling he is paying too much for intangibles.

And that is how a group of manufacturers of a great diversity of product and basic interests can through pooled efforts achieve so much for so little.

Index Available

ELECTRICAL WORLD'S semi-annual index, which prior to the war was included in the last issue in December, is being printed separately and will be available shortly. In all probability, this is the last time it will be necessary to handle the index in this manner as we are hopeful that with the index for the first six months of 1946 we may resume our practice of binding it in with the last issue in the volume.

The current index may be obtained by subscribers without charge on request. Address Editor, ELECTRICAL WORLD, 330 West 42nd Street, New York 18, N. Y.

WASHINGTON COMMENT

By R. N. LARKIN, Washington Correspondent

No U.S. Program Yet for German Power

FOR SIX MONTHS the Foreign Economic Administration has sat doggedly atop a report on what should be done to the German electric power industry to insure that Germany's post-war economy, powerwise, shall be one which will render that country incapable of ever again threatening world safety.

The power report is but one of 25 or 30 similar reports which have been suppressed for reasons which are neither particularly good nor entirely the fault of FEA, which has been hampered by the State Department. Likewise the State Department itself has been hindered by the failure of top administration people to drive forward to a conclusion on the program which must be advanced by this country if its determination to render Germany incapable of future aggression is to be realized.

February 2 Deadline

Fifteen months ago, select committees recruited from government and civil experts were given their assignments. By last July, the individual industry reports had been turned in. By next February 2, the United States must, under the terms of the Potsdam reparations agreement, have agreed with the United Kingdom, France and the U.S.S.R. on a program for disarming Germany industrially. On December 15, the United States had no plan of its own. What some Washington people feel to be as important a battle as any fought in this war has become a white-collar leaf-raking project.

While it refused to disclose the contents of any of the individual reports, FEA sent them overseas for the guidance of military government people. These people have been uncertain as to what use to make of them, realizing that they had no formal status as U. S. policy, but aware that they were the work of government committees and were distributed by a government agency.

American power investigators under the Technical Industrial Intelligence Committee reported several failures in their investigatory assignments because equipment they sought had been removed by the Russians. It now develops that even U. S. troops are destroying power equipment which one might suppose, in the light of destruction wrought by the Nazis beyond their own borders, would be coveted as reparations. Included in an I. G. Farben powder plant destroyed near Munich recently were three 2,500-kva. steam turbine-generators and boilers to serve them. It is possible that this was special purpose equipment of small general value. Perhaps the machines were not worth the transport required to make them available in another country.

The fact remains that in the absence of any U. S. policy on what the allowable German economy shall be—which policy would control what the German power system shall be—U. S. troops have progressed in their occupation duties to a point at which they are picking and choosing power equipment as between its use for reparations, destruction, or retention for the yet undefined German industrial machine.

FPC Loses Independent Status

FEDERAL Power Commission lost a battle it might have won last week when the federal reorganization bill passed without exempting FPC from the re-shuffling powers granted President Truman.

The bill had been before Congress some months when it was reported early this fall and passed by the House without FPC exemption, and with exemption by the Senate.

After weeks of work, the conference committee reported a compromise version last week, and two hours before the House met to consider it, at least some FPC people were unaware that they were not exempt. On learning the bad news, they concentrated their efforts in the Senate.

The trouble with this strategy was that when the conference report arrived in the Senate, it had been adopted by the House, thus was not susceptible of further compromise. The Senate had to take it or leave it. Under the circumstances, Sen. Robert LaFollette, Wisconsin Progressive and foremost Senate champion of FPC, didn't have a chance of junking the report, which then was FPC's only hope of exemption.

Reorganization Plans Uncertain

It is not presently known whether FPC will be reorganized. Before this can happen, some one in the Administration must draw up a plan and sell it to the Administration leaders in Congress—assure in advance that it is one which will not stand in great danger of being rejected at the Capitol. Thus, FPC's independence does not stand to be violated tomorrow. On the other hand, like the small boy with the gun, the Administration has the power to do a drastic job of administrative facelifting, and the presumption can only be that it plans to do a good deal of it. It must further be assumed that broad reorganization plans are already under preparation, perhaps near completion, for Mr. Truman asked the authority shortly after he took office.

Immediate speculation about what might happen to FPC, if the decision be to reorganize it, is that it would go either to the Commerce or the Interior Department. People with every opportunity to know say that Interior Secretary Harold L. Ickes has felt for years that FPC should be in his department. They add that FPC's planning organization probably should be in Interior from any logical administrative viewpoint. But they blanch at the prospect of the Commission's regulatory duties being assigned to a Cabinet officer whose jurisdiction also includes agencies FPC regulates in some way.

Thus, while there is no prediction that it will happen, these observers believe that no intelligent administrator can examine the possibility of reorganizing FPC without realizing it might logically be dismembered.

NEWS OF THE WEEK

Senate Aids Public Power, Adds to Appropriations

Upper Chamber Passes Deficiency Appropriation Bill with Funds for Many Projects and Bureaus Increased—Central Valley Gets More Money for Transmission Line—Bill Now Goes to Conference Committee

The Senate came to the rescue of public power last week when it beat down an attempt to cut off all funds for Central Valley transmission lines and passed the Deficiency Appropriation Bill with an additional $8,285,200 for Reclamation Bureau power projects, some of it allocated to lines which the House had refused completely.

As reported to the Senate by its Deficiency Appropriations Subcommittee, the bill had no provision even for the modest Central Valley transmission line program to which the House agreed although several other power projects, including transmission lines, were increased by subcommittee recommendation. The Upper Chamber, however, resolutely put aside all temptation and restored the $730,000 which the House had approved for a 230-kv. Oroville-Sacramento line.

The Central Valley vote, after considerable debate in which several Senators who hitherto have not done so took the floor against Reclamation in the transmission line and steam plant fight, was 27-38. This was a little better than the Central Valley vote on last spring's regular Interior Appropriation Bill and four votes better than the 27-42 defeat of the Bailey Amendment to the Flood Control Bill just a year ago.

The Senate also added $2,900,000 to the War Department's Flood Control appropriation, raising it to $84,659,000, and struck from the authorization a House-imposed prohibition against building the Garrison Dam with a pool elevation higher than 1,830 ft. Army Engineer plans for the dam, a keystone of the Missouri River development program, call for a 1,850-ft. dam, which residents of the area said would flood part of the city of Williston, N. D.

Federal Power Commission was given an extra $100,000 for administrative expenses and $50,000 for flood control surveys, raising the total appropriation to $350,000.

No change was made in the Securities and Exchange appropriation of $166,200 for administrative expenses.

In boosting Reclamation Bureau appropriations, the Senate started by adding $600,000 to the House-approved $200,000 for administrative expenses. It added $1,000,000 for general investigations and increased the $5,000,000 Davis Dam item by $1,800,000, which represents the cost of a second 115-kv. transmission line from Phoenix to Tucson, Ariz., an item the House had turned down entirely.

The Kings River project, in California, which the House had left out of the bill, was inserted by the Senate with a $197,000 appropriation for power and irrigation studies, and the House-approved item of $5,000,000 for the Colorado-Big Thompson project was boosted to $6,500,000, of which $500,000 was for 35 miles of 115-kv. line from Sterling to Holyoke, Colo., to pick up an R.E.A. co-op load which the Holyoke Municipal System is unwilling to serve further. This item had been refused by the House. The Columbia Basin Project item, most of it for irrigation of land near Grand Coulee Dam, was raised from $10,050,000 to $10,500,000.

The Colorado River Development fund was raised from $250,000 to $1,000,000, and the Fort Peck item was boosted from $480,000 to $1,335,000. Of the latter increase, $190,000 is for an 84-mile, 69-kv. line from Glendive, Mont., to Miles City, $45,000 is for a substation at Miles City; $370,000 is for transmission lines to distribution substations within the Fort Peck System; and $250,000 is for distribution substations to serve irrigation pumping and commercial power loads.

The Missouri River Basin item was boosted from $10,269,100 to $11,402,300, but the increase was allocated to other Interior offices to finance investigations.

The measure went to Conference Committee early this week, and, with both houses anxious to pass the bill and clean up other work before taking a Christmas recess, December 21, it was to be expected that Senate conferees might yield on items they would hold out for on other occasions.

•

FPC Gets No Protection Against Reorganization

The Federal Reorganization Bill under which the Federal Power Commission could be consolidated with any federal agency awaited the signature of President Truman early this week after both House and Senate agreed to a conference report last week.

Only the Securities and Exchange Commission and the civil functions of the Army Engineers were exempted from the sweeping re-shuffling powers granted the President. Sen. Robert LaFollette, Wisconsin Progressive, attempted to extend the exemption to FPC but because of the Parliamentary situation which obtained when the conference report reached the Senate, was unable to do so.

Protesting against the failure to exclude the FPC from provisions of the bill, LaFollette told the Senate:

"I cannot understand the reason for

the treatment which has been given by the conferees to the Federal Power Commission. FPC belongs in the same category with the other agencies which have been exempted, and yet it has been left naked to the winds. I cannot understand what motivated the conferees in according such treatment to that agency unless it be that the agency has been active in protecting the consumers of this country."

•

Industrial Electronics Today and Tomorrow

"The future of industrial electronics can best be predicted and influenced by extending the existing uses of electronics. . . . We need only, however, to concern ourselves with electrons freed from the bondage of matter, which is the science of electronics, to predict a bright future for this particular field of engineering," stated E. H. Alexander, engineer, control division of General Electric Co., in an address before a group of business paper editors in New York at the twelfth and concluding session of the G. E. Industrial Electronics course.

Forty-one editors were enrolled in the course which is available to groups of electrical personnel everywhere. The course consists of talking slide films and booklets.

Based on present day uses, some prospective industrial applications of electronics were outlined by Mr. Alexander, as follows:

Micro-waves—This tool has some promise of supplanting light beams now used with photoelectric relays, and the unique transmission possibilities of being "piped" around corners are interesting.

Dielectric Heat—Food technologists are looking to this source of internal heat for dehydration and sterilization of food products.

Thy-mo-trol (electronic motor control)—A packaged system for a 75-hp. drive is in the building process, and a 600-hp. drive is in prospect. This type of control for ship propulsion and even main-line locomotive drives is in the offing.

Electronic Inspection of Surfaces—The technique of the television camera has been suggested as a means for the inspection of surfaces of material in motion, such as strips of metal, cloth and rubber. A centralized quality control system may result.

Resistance Welding—Because of electronics every joint will "write" on a permanent record of its own certification of strength. An electronic weld recorder would do the job.

Light Sources—Neon, sodium vapor, and mercury vapor lamps, fluorescent lamps, germicidal lamps, Circline and Slimline are sources of light which are electronic devices, and their development is a reminder that electronics will play a definite part in the future of light sources.

CHRISTMAS GREETINGS—Many utilities are illuminating their office buildings for the holiday season. Among them is the Potomac Electric Power Co. in Washington

•

2 Floating Power Plants Will Be Placed on Sale

The War Department has declared surplus two of the four war-built 30,000-kw. floating power plants, one of which will be offered for sale at Antwerp, 5, Belgium, where it has been serving for some time. The second will be offered for sale in this country.

While no final decision had been made early this week, it appeared that the Interior Department would not claim the unit to be sold here under the priority afforded federal agencies by the Surplus Property Disposal Act. Months ago, an Interior subdivision had been interested in purchasing the floating power plant now in use at Jacksonville, Fla.

To be disposed of in Belgium by the Foreign Liquidation Commission is the Resistance, which was fitted with a bow and rudder for seagoing purposes and which was converted to operate at 50 cycles. Now in the hands of the Reconstruction Finance Corporation at the Philadelphia Navy Yard is the Seapower, which also was used in the European theater.

Union Electric Power Co. Sues Illinois Power Co.

Union Electric Power Co. recently filed a suit in the St. Clair County Circuit Court at Belleville, Ill., against Illinois Power Co. to recover $390,212 claimed to be due on a contract for electric power supplied in Madison and St. Clair Counties. The petition alleged that Illinois Power owed $3,143,212 for electric current provided between November, 1944, and September, 1945, but has paid only $2,753,000. Both companies are affiliates of the North American Co.

Allen VanWyck, president of Illinois Power, in commenting on the suit, said that the contract with Union Electric was a point in a $9,000,000 claim filed by Illinois Power against the North American Co. This claim is pending before the Securities and Exchange Commission.

It is understood there has been a controversy over the interpretation of a variable charge based on total consumption in the Union Electric contract.

•

Co-op Lines Approved

South Kentucky Rural Electric Cooperative Corp. has been authorized by the Kentucky Public Service Commission to construct 990 miles of extensions in Adair, Casey, Clinton, Lincoln, McCreary, Pulaski, Russell, and Wayne Counties. The cost will be $1,020,000.

Symington of SPA Would Close Magnesium Plants

Surplus Property Administrator Advises Congress That Privately Owned Plants Can Supply Nation's Needs—Certain Government Plants Would Be Kept in Standby Condition or Partial Production

The government's 13 magnesium reduction plants would be kept out of production—some of them held for standby—under a report submitted to Congress recently by Surplus Property Administrator W. Stuart Symington.

Symington pointed out that privately owned plants will be able to supply the nation's foreseeable demands over the next few years, and that the government now owns a stockpile of virgin and scrap magnesium equal to two years' normal consumption.

Three privately owned plants have an annual production capacity of 30,000 tons. Government plants, costing about $370,000,000, have annual capacity of 263,000 tons.

Government-owned plants which Symington recommended be retained in standby condition, or in partial production if need be, are the Dow Chemical plant at Freeport, Tex.; Dow Magnesium plant, Velasco, Tex.; Diamond Magnesium plant at Painesville, O.; the Magnesium Reduction plant at Luckey, O.; the Electrometallurgical plant at Spokane, Wash.; and the New England Lime Co. plant at Canaan, Conn.

Suggested for sale or conversion to other work were the Basic Magnesium plants at Las Vegas and Gabbs, Nev.; the Dow plant at Ludington and Marysville, Mich.; International plant at Austin, Tex.; Permanente plant at Manteca, Calif.; Amco plant at Wingdale, N. Y.; Ford Motor Co. Magnesium plant at Dearborn, Mich.; and the Mathieson plant at Lake Charles, La.

Despite an assertion in the Symington report that "power is a significant factor in costs of the electrolytic process, the Diamond Magnesium plant at Painesville has the second highest power cost—4.77 cents per pound—of any of the seven electrolytic process plants. The process requires from 8.5 to 10 kw.-hr. per pound of magnesium. Of these electrolytic process plants, which the report recommended be kept in standby condition, the Dow plants at Freeport-Velasco, Tex., have the lowest power costs, 1.58 cents per pound. The three ferro-silicon process plants which were recommended for retention as standbys include the one with the highest power cost, the Electrometallurgical plant at Spokane paying Bonneville 2.26 cents per pound, but the Luckey, O., plant, at 0.44 cents per pound, and the Canaan, Conn., plant, at 0.86 cents per pound had the second and third lowest power costs of all ferro-silicon plants. These two were recommended for retention.

The Dow-Texas plants were served by two power stations, one of which had a 20,000-kw. steam unit—owned by Defense Plant Corporation, but installed in Dow's station. The Velasco station has three steam turbines, one 35,000-kw., one 40,000-kw., and one 45,000-kw. Dow has the right of first refusal on these plants. These generating stations, along with that serving the Mathieson plant at Lake Charles, La., the latter of which had the lowest power costs of any electrolytic plant at 1.11 cents per pound, or slightly over 1 mill per kw.-hr., both used low cost natural gas for fuel.

The Mathieson station had eight 7,500-kw. steam turbines, of which six were in standby shape, one 15,000-kw. and one 35,000-kw. unit. Both the two larger machines were in standby shape, and the latter was sought by the Interior Department for return to Lake Catherine, Ark., to the Jones Mills Aluminum plant power station, for which it was designed originally. The Symington report appraised the Mathieson steam power station as the Lake Charles plant's most valuable selling asset for other uses.

Commenting on the power costs at the Diamond-Painesville plant and the Dow-Michigan plant, the report noted that "the eastern plants suffer from the high costs of coal-generated power," adding:

"Rates set by private utilities at Painesville and Dow-Marysville need to be explored to see if some re-adjustment is possible, now that war demands for power in these industrial areas have dropped off."

Harking back to criticism by members of Congress of the cancellation charges imposed on DPC by the Bonneville Power Administration in connection with energy contracts between BPA and DPC for aluminum magnesium plants in the Pacific Northwest, the Symington report cited disadvantages accruing to Northwestern magnesium plants from "inflexible" Bonneville contracts.

"The contracts with government power authorities for sale of blocks of power on an inflexible basis have been a handicap to both the electrometallurgical Spokane plant, (which buys from Bonneville) and the Basic Magnesium plant (which buys from Boulder Dam.) If secondary power could be used (and it should be available in large quantities on a relatively firm basis now that the war is over) or if the firm power rates could be made on a flexible basis, it would enhance the disposal value of these two plants, whether for magnesium or for other electrochemical uses."

CONGRATULATIONS—L. M. Klauber, left, vice-president of San Diego Gas & Electric Co., receives the congratulations of K. M. Ryals, president of the Pacific Coast Electrical Association, for his recent address at the meeting of the association in which he predicted atomic energy will be no threat to utilities for years to come

•

Albuquerque Utility Plans $215,000 Expansion Outlay

Plans of Albuquerque Gas & Electric Co. to expand its electric service in Albuquerque, N. Mex., at an outlay of $215,000, were announced recently by Arthur Prager, president and general manager. He made the announcement upon his return from New York where he conferred with officials of the Federal Light & Traction Co., the parent firm.

Work will consist mainly of rebuilding many of the company's overhead distribution lines and installation of two new substations, one of 6000 and the other of 2000-kw. capacity.

Prager said materials already have been ordered, and work will start as soon as they are delivered.

Ontario and Quebec Will Develop Ottawa

Ontario Hydro Commission Will Build 400,000-Hp. Plant at Des Joachims and 2 Smaller Plants

An agreement between the Provinces of Ontario and Quebec concerning the power development of the Ottawa River, boundary between the provinces, has cleared the way for a five-year, $200,000,000 expansion program of the Hydro-Electric Power Commission of Ontario.

Long sought by both provinces, the agreement, which has been approved by both legislatures, gives Ontario exclusive rights on the upper half of the Ottawa River and Quebec exclusive rights on the lower half. (For map of river and possible power sites see ELECTRICAL WORLD, December 30, 1944, Page 5). The Federal Government has abandoned its rights on the river to the provinces.

Projects already announced by Dr. T. H. Hogg, chairman of the Hydro-Electric Power Commission of Ontario, include a 400,000-hp. plant at Des Joachims at a cost of $50,000,000; transmission lines and terminal stations for delivery of power from the new plant, $20,000,000; a 50,000-hp. plant at Stewartville, near Arnprior, on the Madawaska River, $7,500,000; and a 70,000-hp. expansion at the DeCew Falls plant on the Welland River, $7,500,000.

At Des Joachims, which is 200 miles north of Toronto and 160 miles northwest of Ottawa, there will be a concrete dam 2,500 feet long and 135 feet high. A control dam will also be constructed to regulate the water. Power will be used in the southern Ontario system, including Toronto and the district extending from Cornwall to Windsor. It is expected that the first power will be available in 1949.

Dr. Hogg said the decision as to whether the development will be 25 or 60-cycle, which are both used in the province, has not yet been made but will hinge to a large extent on the action the hydro municipalities comprising the southern Ontario system take in deciding upon a changeover.

The dam will create a lake about a mile wide and extending up river for perhaps 80 miles. Several miles of the main line of the Canadian Pacific Railway will have to be moved as will a number of highways. Most of the territory is Crown land.

Power from the DeCew expansion will be available by the summer of 1947 and from Stewartville by fall of the same year.

•

Range Installation Cost Set at $15 by Duquesne Co.

To encourage the use of electric ranges, Duquesne Light Co. has announced that it will make a standard range wiring installation for $15 if the range is to be located on the first floor of a single family dwelling. The company will also make liberal contributions toward the cost of installing range wiring in duplexes and apartments.

Other conditions in addition to the one specifying the location of the range are that the applicant purchase service directly from the company, that the range have a thermostatically controlled oven with a minimum of three surface units and be the main cooking device, and that conditions are those existing in the average residence. The plan does not apply to such cases where the building is served by underground service or is more than 100 feet from the company's overhead lines.

Included in the standard installation price of $15 is the replacement of wiring from the bracket of the house to and including the main switch, the range circuit, the range receptacle, and the connections to existing wiring or distribution center.

September Energy Sales Drop 8.4%

Sales of electric energy to ultimate customers in September, 1945, totaled 14,890,243,000 kw.-hr. compared with 16,259,701,000 kw.-hr. in September, 1944, a decrease of 8.4 percent, according to the report issued by the Edison Electric Institute.

Revenue from ultimate customers amounted to $267,913,400 in September, compared with $270,242,400 in September, 1944, a decrease of 0.9 percent.

For the twelve months ended September 30, 1945, the annual use per customer advanced to 1,202 kw.-hr. from 1,132 kw.-hr. for the preceding year, an increase of 6.2 percent; the average annual bill to $41.47 from $40.07; revenue per kilowatt-hour dropped to 3.45 cents from 3.54 cents, a decrease of 2.5 percent.

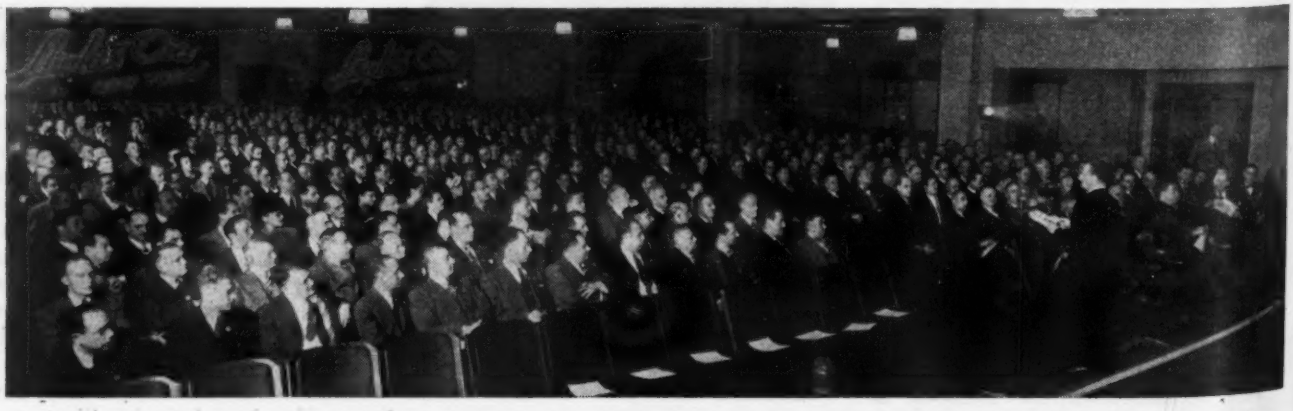
Classification of Sales, September, 1945 and Change from 1944

Kilowatt-hour sales	Million Kw.-Hr.		%
September	1945	1944	Change
Residential or domestic	2,693	2,483	+8.4
Rural (Distinct rural rates)	383	358	+6.8
Commercial or industrial			
Small light & power	2,477	2,527	—2.0
Large light & power	8,023	9,504	—15.6
Street & highway lighting	175	174	+0.4
Other public authorities	562	624	—10.0
Railways & railroads			
Street & interurban	333	345	—3.4
Electrified steam railroads	200	208	—4.0
Interdepartmental	45	36	+25.3
Total to ult. customers	14,890	16,260	—8.4

•

Reduction Cuts Taxes

Michigan Public Service Commission has ordered Consumers Power Co. to reduce its December bills for electric, gas, and steam services approximately $1,000,000. The reduction is said to wipe out virtually all of the company's excess profits tax for 1945.



START OF A CAMPAIGN TO IMPROVE LIGHTING—E. F. Jeffe, vice-president in charge of sales, Consolidated Edison Co., gives 600 appliance dealers and distributors details of an intensive campaign for improving lighting in New York City

Leland Olds Elected Chairman of FPC

Leland Olds was elected chairman of the Federal Power Commission this week, and Nelson Lee Smith was elected vice-chairman.

Olds returned to the chairmanship a year and one-half after having left it. He will hold office until the expiration of his term, in June, 1949. The vice-chairmanship is Smith's first commission office, and his term will extend through 1946. Olds became acting chairman last October 1, when former Chairman Basil Manly resigned.

Olds was appointed to FPC in June, 1939, by President Roosevelt. He became chairman a year later and held that office until his term expired in June, 1944. When his reappointment was confirmed in September, 1944, he was elected vice-chairman.

From 1931 until his appointment to FPC Olds was executive secretary of the New York State Power Authority. In 1936, he was a member of a presidential commission assigned to study European cooperatives. In 1939 he became vice-chairman of the National Power Policy Committee and a member of the Water Resources and Energy Resources Committees of the National Resources Planning Board. In 1940 he was appointed chairman of the United States St. Lawrence Advisory Committee and a year later became a cosigner of the executive agreement between the United States and Canada regarding development of the Great Lakes-St. Lawrence Basin.

Commissioner Smith was appointed to FPC in October, 1943, to fill the unexpired term of the late Clyde Seavey and was reappointed last June. Since September he has been supervising commissioner in the natural gas investigation. A resident of New Hampshire, he was a member of the New England Governors' Railroad Committee from 1929 until 1931, studying the problems of railroad consolidation. In 1933, he became a member of the New Hampshire Public Service Commission and became chairman a year later. He left the Commission in 1941 to become chairman of the Board of Investigation and Research under the Federal Transportation Act of 1940. This position he held until his appointment to FPC.

•

Michael Straus Sworn In

Michael W. Straus was sworn in this week as Commissioner of the Interior Department's Bureau of Reclamation. Straus replaced Harry W. Bashore, who retired after almost 40 years with Bureau.

JENNISON STATION DEDICATION—Top: Ralph D. Jennison, for whom the plant is named, beside the commemorative plaque erected by his associates in the New York State Electric & Gas Corp. Bottom: Part of the more than 200 guests dine

N. Y. State Electric Dedicates Station

Jennison Station, third in a series of plant additions to the system of New York State Electric & Gas Corp. within less than five years, was dedicated on December 13. The plant, designed to burn anthracite culm (ELECTRICAL WORLD, December 8, Page 118), has the largest traveling grate stoker ever made for utility use. At the present time the station has one 30,000-kw. turbine, served by two boilers with 400,000 lb. per hour steam capacity.

Because the plant located at Bainbridge, N. Y., was designed under war restrictions, it has incorporated in it many features reflecting those conditions. Very little copper, for instance, was used, and the coal bunkers were made of concrete instead of steel.

In dedicating the plant Ralph D. Jennison, president of the corporation and for whom the plant is named, stated that while this plant completes a total addition of 127,000 hp. to the system's capacity in less than five years, the company will continue to do as much or more as may be needed to give to south central New York electric service second to none.

•

MVA Hearings Extended

The Senate Agriculture and Forestry Committee has been given until March 15 to submit a report on the bill to establish a Missouri Valley Authority. The original 60-day limit expires the end of this month.

Hearings have not yet been scheduled but probably will be held in February. Senator James E. Murray, Montana Democrat and author of the bill, is attempting to have them held in the region. Two other committees have held extensive hearings in Washington.

Speech and Power Travel Same Lines

Test of 4 Instruments on Lines of Arkansas Co-op if Successful Will Increase Rural Telephones

Telephone communication over rural power lines moved a step closer to reality this week as a test installation of four instruments went into operation near Jonesboro, Ark., where electronic instruments developed by the Bell System were installed on lines of the Craighead Electric Cooperative Corp., of Jonesboro.

REA Administrator Claude R. Wickard asserted that the test, if successful, may open the way for the extension of telephone service to many unserved rural dwellers who have or will receive electric service.

A similar test installation is scheduled to be put into operation shortly near Selma, Ala., using lines of the Alabama Power Co. The equipment was developed by the Bell System, which started working on the problem before the war and is just now resuming work which was halted by war. REA assigned engineers to the project in 1939 in an effort to develop a means of speeding up communication between line crews and home offices. Since then, numerous tests have been made in the field, but the Arkansas installation is the first for continuous operation. Field tests have been "encouraging," but further testing is necessary.

3 Radio Frequencies Used

While it looks like a standard instrument, the carrier-type phone uses three radio frequencies in the 150-500-kc. range, below the standard broadcast band. One frequency carries the sound waves out, one brings sound waves in and a third is for signaling. An electronic device hung on the pole prevents the power from leaking into the phone system, and central station facilities allow calls to be switched from system to system. One of the problems was to prevent mutual interferance from the low-frequency, high-voltage power and the high-frequency, low-voltage carrier currents, each of which use the same wire. Reflections from branch lines also had to be eliminated and safety devices for users provided.

"REA and its borrowers will be glad to continue cooperating with the telephone industry in its work on carrier telephones," Wickward declared. "We look forward to the larger opportunity for rural service which is promised in this development. The worth of REA-financed rural electric systems to the nation will be increased immeasureably if the same lines which have brought the blessings of electric light and power to rural homes can also be used efficiently to link these homes together in the nation's great telephone network."

•

Portland Electric Power Hearing Set for January 2

What is hoped will be the final hearing in the reorganization case of Portland Electric Power Co. has been set for January 2 at Portland, Ore., by United States District Judge James Alger Fee.

One of the major proposals under consideration in the long-drawn-out reorganization case provides that the stock of Portland General Electric Co. and Portland Traction Co., subsidiaries of Portland Electric Power, shall be sold and the proceeds distributed among the stockholders. Previously it had been suggested that a new issue of stock be distributed to the stockholders.

•

Franchise Extended

Citizens of Litchfield, Mich., have voted to extend the franchise of the Consumers Power Co. for another 30 years.

Utility Operating Revenues Drop 1.0% in September

Electric operating revenues of the larger privately owned electric utilities in the United States in September, 1945, were $254,718,000, as compared to $257,216,000 in September, 1944, a decrease of 1.0 percent, according to figures released by the Federal Power Commission.

Revenue deductions (including operating expenses, depreciation and taxes) were $196,234,000 or 0.9 percent under those of September, 1944.

Gross income, including other utility operating income, decreased 1.2 percent to $65,693,000 and net income in September, 1945, was $40,470,000, an increase of 3.6 percent from the net for September, 1944.

•

Utility Sale Approved

New Mexico Public Service Commission has approved the sale of the franchises and assets of the Dawson Division of the New Mexico Power Co. to the Trinidad Electric Transmission, Railway & Gas Co. of Trinidad, Colo., for $526,101. The Dawson Division operates in Colfax and Mora Counties of New Mexico.

MEETINGS

National Association of Purchasing Agents—Public Utility Buyers' Group, midwinter convention, Edgewater Beach Hotel, Chicago, Ill., February 4-5. R. C. Wenz, chairman, Philadelphia Co., Pittsburgh 19, Pa.

American Society for Testing Materials—Spring meeting, Pittsburgh, Pa., February 25 to March 1. R. E. Hess, assistant secretary, 260 S. Broad St., Philadelphia 2, Pa.

National Rural Electric Cooperative Association—Annual meeting, Buffalo, N. Y., March 4-6. Avery C. Moore, secretary-treasurer, 416 5th St., N.W., Washington 1, D. C.

North Central Electrical Industries—Convention and trade exposition, Radisson Hotel, Minneapolis, Minn., March 10-14. W. A. Ritt, secretary-manager, 234 Foshay Tower, Minneapolis, Minn.

Edison Electric Institute—General sales conference, Edgewater Beach Hotel, Chicago, Ill., April 2-4. Col. H. S. Bennion, managing director, 420 Lexington Ave., New York 17, N. Y.

Midwest Power Conference—Annual meeting, Palmer House, Chicago, Ill., April 3-5. S. E. Winston, director, Illinois Institute of Technology, Chicago 16, Ill.

National Electrical Manufacturers Association—Spring meeting, Palmer House, Chicago Ill. week of April 8. W. J. Donald, managing director, 155 E. 44th St., New York 17, N. Y.

Missouri Valley Electric Association—Engineering conference, Hotel Continental, Kansas City, Mo., April 10-12. I. D. Pettegrew, director, 1004 Baltimore St., Kansas City 6, Mo.

Electrochemical Society—Spring meeting, Tutwiler Hotel, Birmingham, Ala., April 10-13. Colin G. Fink, secretary, Columbia University, 3000 Broadway, New York 27, N. Y.

National Electrical Wholesalers Association—Annual convention, Stevens Hotel, Chicago, Ill., April 21-25. C. G. Pyle, managing director, 500 Fifth Ave., New York, N. Y.

American Institute of Electrical Engineers—Northeastern district, Buffalo, N. Y., April 24-25. H. H. Henline, national secretary, 33 W. 39th St., New York 18, N. Y.

International Lighting Exposition—Stevens Hotel, Chicago, Ill., April 25-30. A. B. Coffman, manager, 111 W. Jackson Blvd., Chicago 54, Ill.

Previously Listed

American Institute of Electrical Engineers—Winter convention, New York, N. Y., January 21-25. H. H. Henline, secretary, 33 W. 39th St., New York 18, N. Y.

Institute of Radio Engineers—Winter technical meeting, Astor Hotel, New York, N. Y., January 23-26. Haraden Pratt, secretary, 330 W. 42nd St., New York 18, N. Y.

Pennsylvania Electric Association—Systems operation committee, Roosevelt Hotel, Pittsburgh, Pa., February 6-7; A. R. Deck, chairman, Metropolitan Edison Co., 412 Washington St., Reading, Pa. Transmission and distribution committee, Benjamin Franklin Hotel, Philadelphia, Pa., February 7-8; C. C. Moler, chairman, The Potomac Edison Co., Hagerstown, Md. Electrical equipment committee, Roosevelt Hotel, Pittsburgh, Pa., February 14-15; B. E. Hagy, chairman, Philadelphia Electric Co., 900 Sansom St., Philadelphia, Pa.

Canadian Electrical Association—Winter conference, Chateau Frontenac, Quebec City, February 11-12. B. C. Fairchild, managing director, 704 Tramways Bldg., Montreal, Canada.

Missouri Valley Electric Association—Power sales conference, Hotel Continental, Kansas City, Mo., February 13-14. I. D. Pettegrew, director, 1004 Baltimore St., Kansas City 6, Mo.

Reclamation Bureau Will Aid on Chinese Projects

A contract providing U. S. technical assistance for China in its Yangtze River development program, but requiring no financial commitment by this country, has been signed by the Chinese government and the Bureau of Reclamation.

Interior Secretary Harold L. Ickes announced last week that the Bureau will collect a $500,000 fee for designs and specifications of Yangtze engineering projects, perhaps including the Yangtze Gorge dam, which was described in ELECTRICAL WORLD, March 17, page 97. This dam, larger than Grand Coulee, would be planned for an ultimate power capacity of more than 10,000,000-kw. The dam, near Ichang, would back up a lake more than 250 miles in length. Other dams and widespread irrigation facilities also are in the list of possible projects. It would be up to the Chinese government to finance the projects, which might take as much as 25 years to build.

Designing will be done in Reclamation's Denver office under the direction of J. L. Savage, who toured China and chose potential damsites, including that of the Yangtze Gorge project. Savage designed Grand Coulee, Shasta, and Boulder dams, among others.

•

Saskatchewan Purchases Prairie Power Company

The Prairie Power Co., Ltd., with headquarters at Regina, has been purchased by the Saskatchewan government from the Calgary Power Co. for $1,462,000.

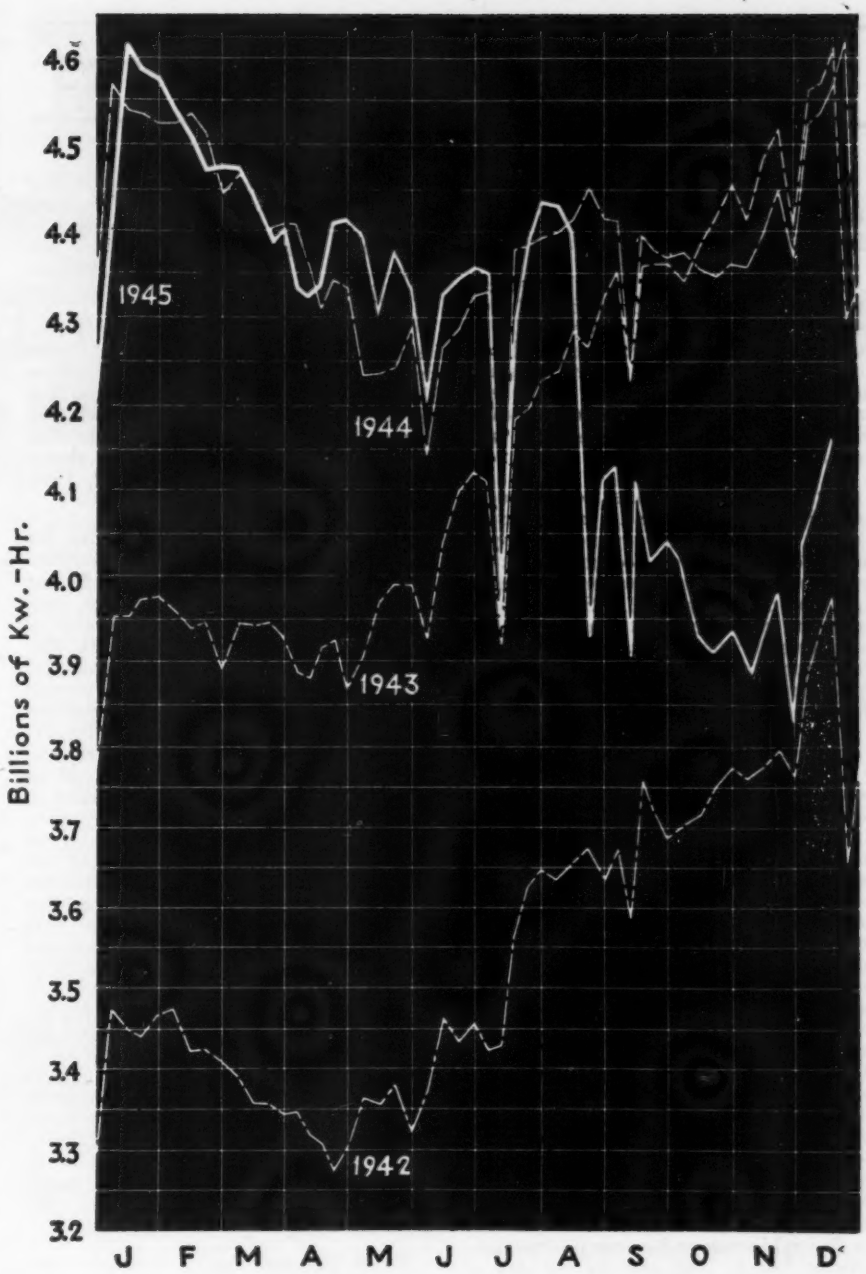
On December 1, the Saskatchewan Power Commission took over the operation of the property. W. E. Ross, Saskatchewan manager of the private utility, has joined the commission as superintendent of the transmission lines. All other employees were retained by the commission.

Prairie Power Co. operated 600 miles of transmission lines serving 53 towns and villages in southeastern Saskatchewan. It bought power wholesale and resold it to other utilities and to municipalities.

•

Askansas Lines Approved

Arkansas Public Service Commission has authorized Arkansas Power & Light Co. to build 126 miles of distribution lines in Hot Springs and Clark Counties. South Central Cooperative was authorized to construct 170 miles in the same counties.



Output Curve Gains More Ground

The electric output curve continued to move upward during the week ended December 15, 1945, according to figures released by the Edison Electric Institute. The amount of electrical energy distributed by the light and power industry totaled 4,154,061,000 kw.-hr., compared with 4,096,954,000 kw.-hr. during the preceding week. During the week ended December 16, 1944, the amount of electrical energy distributed amounted to 4,563,079,000 kw.-hr., this year's figure representing a decrease of 9.0 percent.

All of the major geographical regions of the country reported losses for the week ended December 15, as compared with the same week last year, according to the report by the Institute.

Weekly Output Millions Kw.-Hr.

1945		1944		1943	
Dec. 15	4,154	Dec. 16	4,563	Dec. 18	4,613
Dec. 8	4,097	Dec. 9	4,538	Dec. 11	4,567
Dec. 1	4,043	Dec. 2	4,524	Dec. 4	4,560
Nov. 24	3,841	Nov. 25	4,369	Nov. 27	4,403
Nov. 17	3,985	Nov. 18	4,450	Nov. 20	4,513
Nov. 10	3,948	Nov. 11	4,397	Nov. 13	4,483
Nov. 3	3,899	Nov. 4	4,355	Nov. 6	4,414
Oct. 27	3,937	Oct. 28	4,358	Oct. 30	4,453
Oct. 20	3,915	Oct. 21	4,345	Oct. 23	4,415
Oct. 13	3,931	Oct. 14	4,355	Oct. 16	4,382
Oct. 6	4,028	Oct. 7	4,375	Oct. 9	4,342
Sept. 29	4,039	Sept. 30	4,366	Oct. 2	4,359

Percent Change from Previous Year

	Week Ending		
	Dec. 15	Dec. 8	Dec. 1
New England	— 3.2	— 2.0	— 4.0
Mid Atlantic	— 2.7	— 2.2	— 3.7
Central Industrial	— 11.4	— 12.7	— 12.8
West Central	— 1.7	— 1.6	— 1.4
Southern States	— 12.3	— 13.6	— 15.7
Rocky Mountain	— 1.3	— 1.3	— 0.8
Pacific Coast	— 10.8	— 12.5	— 13.0
Total United States	— 9.0	— 9.7	— 10.6

SEC DECISIONS—HEARINGS

The Securities and Exchange Commission recently issued a series of orders affecting electric utility companies.

AMERICAN POWER & LIGHT CO.'s amended supplemental plan, providing for redemption of the Southwestern Power & Light Co.'s 6 percent gold debenture bonds at 110 percent and accrued interest plus an additional 5 percent because the debentures, assumed by American, are not callable until March 1, 1947, has been approved. (Release No. 6258).

ELECTRIC BOND & SHARE CO.'s request that the commission issue an order approving the transfer to the top holding company of certain shares of common stock of its subholding company, National Power & Light Co., owned by Bond & Share beneficially, but registered in the name of six individuals as nominees has been granted. The issuance of new certificates to Bond & Share for such stock also was approved. (Release No. 6266).

AMERICAN POWER & LIGHT CO.'s proposal to sell all of the outstanding securities of its wholly owned subsidiary, New Maxico Electric Service Co., to J. M. Murray Jr., of Hobbs, New Mexico, for $1,206,000, plus $150 a day from last September 30 to the date of closing, has been approved by the commission. In its unanimous decision, the commission exempted the sale from competitive bidding, because the record indicated the buyer and seller are not affiliated; that the transaction resulted from arms-length bargaining, and that the securities have never been publicly sold or listed on any exchange. Prior to the proposed sale, New Mexico will assign to American all claims that it may have against American's parent, Electric Bond & Share Co. and the latter's present or former subsidiary companies. New Mexico and American also have agreed that American shall receive the benefit of any gain or suffer any loss occasioned by New Mexico's over-accrual or under-accrual for Federal income and excess profits taxes, between Jan. 1, 1942, and the last day of the month preceding consummation of the sale. American will contribute to New Mexico 21,650 shares of the latter's common stock, having an aggregate stated value of $433,000 to enable New Mexico to make certain accounting adjustments, and will cause the subsidiary to eliminate $730,992 of estimated inflationary items from its plant account and to increase its property retirement reserve by $53,000. (Release No. 6281).

ASSOCIATED GAS & ELECTRIC CORP. has received commission approval for the post-effective amendments to its amended plan of reorganization. The post-effective amendments increase the authorized principal amount of new debentures from $8,000,000 to $8,400,000, increase the estimated principal amount of new debentures to be outstanding upon consumption of the plan to to $8,000,000 from $7,400,000, provide a form of trust indenture under which the new debentures are to be issued and indicate the conversion rate, pursuant to the formula set forth in the plan, as amended, whereby the new debentures are to be convertible into new common shares of the surviving company on basis of 2.95 shares of new common for each $50 principal amount of new debentures. The amended plan of reorganization of Associated Gas & Electric Corp. was approved by the commission on April 14, 1944. (Release No. 6274).

OHIO RIVER POWER, INC.'s proposal to issue and sell to its parent, Ohio Public Service Co., up to 20,000 shares of its $100 par value common stock and to use the proceeds in financing additional generating facilities has been authorized. The parent company is to acquire the shares from time to time prior to May 2, 1946, at par. (Release No. 6268).

YORK (PA.) RAILWAYS CO.'s plan for reorganization and eventually dissolution and liquidation has been approved by the commission. The plan calls for York Railways to pay the full liquidation value of $4,387,000 for its outstanding bonds, plus $50 a share and accrued dividends for 3,186 shares of publicly held 5 percent cumulative preferred stock. Metropolitan Edison, a subsidiary of the NY PA NJ Utilities Co., would assume all the remaining liabilities of York Railways and as sole remaining holder of 28,814 shares of its preferred stock, all remaining assets. York Railways would sell to the Edison Light & Power Co., a subsidiary, all the former's physical properties for $41,455 and Edison Light also would buy from another subsidiary of York Railways, the York Steam Heating Co., all its franchises and property for $238,298. York Steam Heating then would dissolve. Edison Light would acquire all the franchises and property—real, personal and mixed—of the Glenn Rock Electric Light & Power Co., a NY PA NJ subsidiary, and Glenn Rock Electric would be merged into Edison Light. York Railways then would sell to Metropolitan Edison all the former's holdings of Edison Light stock and other items for a cash consideration sufficient to enable York Railways to pay its obligations. (Release No. 6285).

UNION ELECTRIC CO. OF MISSOURI'S proposal to acquire approximately $91,000 of purchase money and rental notes from its subsidiary, Union Electric Land & Development Co., has been approved by the commission, which also sanctioned payment by the subsidiary to the parent company of all of the former's cash and other assets. (Release No. 6277).

UTILITY REPORTS

	Net Income 1945	1944
*Birmingham Electric	$1,302,100	$1,443,723
*California Electric Power and subs.	1,383,311	1,296,889
*Central Illinois Light	1,451,522	1,426,900
†Central Power & Light	1,769,759	1,780,882
†Florida Power and sub.	1,628,069	1,644,480
†Illinois Power	2,636,574	2,017,184
†Louisville Gas & Electric	1,187,275	1,233,524
†Northern States Power (Del.) and subs.	4,872,589	4,580,036
*Savannah Electric & Power	266,192	397,992
*Sioux City Gas & Electric	664,029	626,194
†West Texas Utilities	1,331,444	1,289,592
†Wisconsin Power & Light	1,326,440	1,582,556

*Twelve months ended October 31.
†Twelve months ended September 30.

NEW ENGLAND GAS & ELECTRIC ASSOCIATION and its subsidiary, New Hampshire Gas & Electric Co.'s joint application-declaration, outlining terms for the merging of the Derry Electric Co. and the Lamprey River Improvement Co. into New Hampshire, has been approved. (Release No. 6273).

Applications Filed

ENGINEERS PUBLIC SERVICE CO. has proposed to sell all 15,000 outstanding shares of capital stock of the Western Public Service Co., a subsidiary, to W. C. Gilman and Associates. The price amounts to $843,000. It is provided in the purchase agreement, dated December 3, 1945, that on or prior to the consummation of the sale, Western will pay its demand note now held by Engineers in the principal amount of $508,000. (Release No. 6280).

BUFFALO NIAGARA ELECTRIC CORP. has filed an application for authority to issue and sell 350,000 shares of its authorized but unissued preferred stock, $100 par value, under competitive bidding conditions. Proceeds, augmented by treasury funds, will be used to redeem the 350,000 presently outstanding shares of preferred stock, 5 percent series, at $105 a share. Details regarding the redemption price of the new series of preferred stock will be supplied by amendment. (Release No. 6272).

NY PA NJ UTILITIES CO. and its subsidiary, Staten Island Edison Corp., in a joint application, have asked the commission to approve certain transactions designed further to simplify Staten Island's corporate structure and free current and future earnings for the payment of dividends. The proposed transactions include the purchase by NY PA NJ of 2,725 shares of Staten Island's preferred stock for $272,500 from another of its subsidiaries, New York State Electric & Gas Corp. These shares would be reclassified into 2,725 shares of new common stock of Staten Island, which proposes to cancel 100,000 shares of Treasury stock and to reduce another 260,000 shares of such non-voting common to 130,000 shares of new voting common stock. Staten Island would transfer its earned surplus as of Oct. 31, 1945, to unearned surplus-special together with $3,174,912 which is to be created by reduction of the company's capital. Staten Island proposes also to declare and pay, from unearned surplus-special, a dividend of $995,437 upon the proposed 132,725 shares of new common stock. (Release No. 6278).

NORTHERN STATES POWER CO. OF DELAWARE, and its subsidiary, Northern States Power of Minnesota, have joined in asking the commission to approve the proposed postponement of the payment of installments on the Delaware company's open account indebtedness due Dec. 31, 1945, and aggregating $1,728,250.91, until December 31, 1946. The joint application stated that it is expected that the indebtedness will be fully extinguished through the proposed liquidation of the Delaware company. Meanwhile the Minnesota company will segregate on its books the sum of $1,728,250.91 of its earned surplus as not being available for dividends on its common stock. (Release No. 6289).

November Bills Cancelled

Grand Island, Neb., Municipal System cancelled all November bills.

HOW

DESIGN · CONSTRUCT · OPERATE · MAINTAIN

Dispatching System for Metermen

J. L. LINEBACK
Superintendent of Meters
Cincinnati Gas & Electric Co.

Metermen pick up the major part of their day's assignments before they leave on their tours, but to minimize travel and achieve efficiency they call headquarters at frequent intervals so that urgent assignments can be given the man nearest the location where the investigation is to be made. To avoid congestion at the receiving phones these calling times are scheduled in advance with such staggering as to have most spread out at quarter-hour intervals. Each man reports two or four times during the day, the foot men once, and those driving automobiles twice in forenoon. The call schedule is repeated in afternoon.

So that the dispatcher can tell in an instant whether there is a special assignment for any meterman when he phones in, there is a clip for each man on the dispatching board. When she has read the instructions to him over the phone she puts the slip in the pigeonhole assigned to him. In this way he has a complete written record of the present day's assignments along with the ensuing day when he reports and opens the door of his particular pigeonhole at the close of his day's work.

PIGEONHOLES AND CLIPS make messages for meter installers readily available to dispatcher Vera Rieckoff whenever any metermen phone in during the day

Distribution Staff Duties Summarized*

Joint Line Representative

In a typical Eastern utility company the joint line representative has general charge of relations with foreign companies concerning the joint use of poles and the maintenance of poles and lines jointly occupied. It is his duty to see to it that agreements concerning such ownership and maintenance are properly executed and that proper charges are made; also that all bills connected with the joint use of poles are checked by him. This official is expected to suspend all unusual joint line construction projects, when the particular benefit is for the foreign company, until these are individually approved by the distribution superintendent. The representative is responsible for the periodic inspection and minor repairs of poles and lines; the issuance of proper orders to make such repairs as are necessary to maintain this property in good condition, and records of such inspections.

Another duty is to keep an up-to-

* One of a series of presentations covering the essential duties of officials of a public utility distribution department serving between 50,000 and 75,000 meters. Organization of the distribution department was outlined in ELECTRICAL WORLD, October 13, 1945, page 106.

date record of all condemned pole replacements including those in foreign company custody. Each case has to be followed up to see that the pole is replaced promptly. Every March he is required to furnish a list of potheads, cable and manholes to be inspected. The representative is held responsible for the file of legal documents located in a vault at the headquarters office of the department and for keeping up to date such records as are necessary to identify each document. Information about unusual troubles reported is to be recorded under his responsibility in an "Unusual Trouble Book" maintained by the department to enable exceptional operating occurrences to be analyzed for the benefit of the department.

Each day when the main office of the department is open for business, the joint line representative is to be present between noon and 1 p. m. in the maintenance supervisor's office to function as trouble operator.

During the last two weeks of March, June, September and December he is required to examine the following kinds of orders, discuss them as may be necessary with the persons to whom they have been issued, and to report to the superintendent of distribution on any cases where such orders have not been completed within a reasonable time: (a) Work orders, incomplete work orders file; (b) Work orders for work under the monthly "blanket" as found in the possession of the general line foreman, distribution clerk, meter superintendent or maintenance supervisor; (c) Trouble Reports, for minor repairs, as found in the possession of the general line foreman or electrical construction foreman.

• • •

House Numbering Made Easy

F. H. MEIER
Consumers Power Co., Muskegon, Mich.

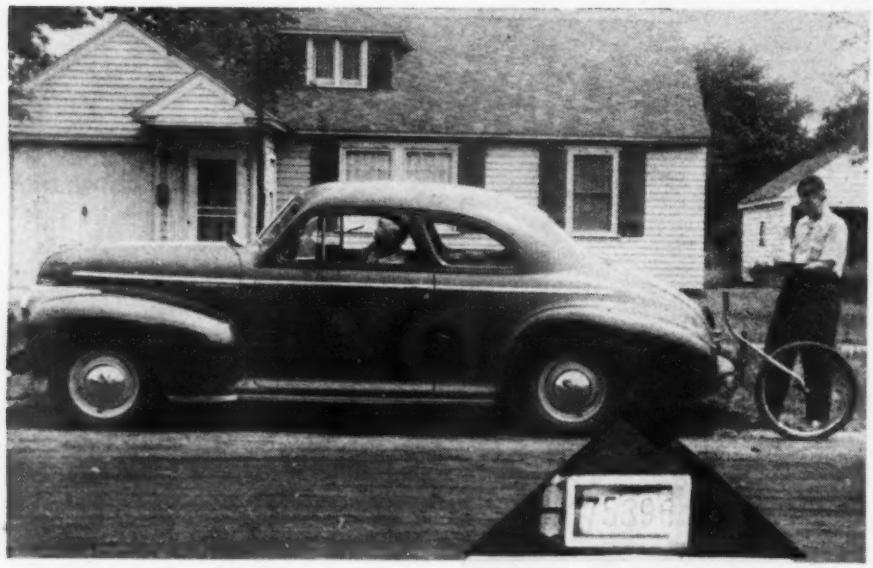
It will no longer be necessary for a customer of Consumers Power Co. in Muskegon County, Mich., to give such directions as this: "I live a mile beyond Stumpy Corners. Turn left at the next road until you reach the ravine, the first house on the left past the big elm tree. You can't miss it!"

Muskegon officials have long favored setting up a house numbering system in the county and finally the project was gotten under way with the cooperation of the Muskegon County Road Commission and the Township Supervisors.

Consumers Power Co.'s part in the project was the numbering and placing of numbers on the houses. Since the Greater Muskegon numbering system was set up on the basis of 800 house numbers to the mile it was logical to follow this plan in the county, starting from the base line roads running North and South, East and West.

It was evident to Avery Knowles and Fred Bolt of the company meter department that the task would take a lot of pacing or use of a measuring wheel to provide the right house numbers for a whole county. To make the job quicker and easier they found a bicycle wheel with a circumference of 6.6 ft. which would thus make 800 revolutions per mile. By placing a revolution counter on this wheel a new number would be turned up at each revolution. This way, regardless of how close or how far apart the houses were, numbers were always available from the counter without any chance for a mixup.

The wheel was set in an ordinary bicycle fork and attached to the rear of a service car as shown by means of a flat iron bar which is in turn bolted to the rear bumper.



MEASURING DEVICE consisting of a revolution counter (inset) on bicycle wheel attached to automobile helps utility to assign numbers to houses in an entire county. The wheel, with a circumference of 6.6 ft., makes 800 revolutions per mile. Houses are numbered on the basis of 800 numbers per mile. County and township authorities cooperated

•

Fault Location Narrowed by Tone on D. C. Network

PAUL B. HULL
Assistant Superintendent, Electric Distribution, Public Service Co. of Colorado, Denver

A "5-cycle" tone applied to a 2½-sq. mi. d.c. distribution system, much of it meshed by alley ties between mains, was recently effective in locating the cause of a heavy ground on the positive side of the system. Contrary to expectations the tone came through in such strength as to be heard in the earphones when the exploring coil was 8 to 10 ft. away from the faulty loop. It was behind this loop that the conductor was found to have cut through the insulation because of the weight involved in a nine-story vertical run. It appeared to have happened during a severe thunderstorm. Apparently the breaker in the ground-lead of the middle wire of the 250/500-volt system, although set for 900-amp. instantaneous trip, opened before the 500-amp. fuse blew. It could not be reclosed because the fault was a permanent one.

After unsuccessful effort to burn the fault clear with 300 amp. for 1½ hours (controlled through a water rheostat) it was decided to try locating the fault with a tone similar to

that customarily employed in tracing underground cables. The tone-generator devised gave about 300 interruptions per minute and was connected between middle wire and ground through enough resistance to limit current to 15 amp. Arcing at the contacts was minimized by shunting with three 24 mf. capacitors taken from mercury-vapor lamp ballasts; at the same time they helped create a sharper, clearer signal in the listening device.

The exploring coil consisted of twelve turns of No. 18 wire wound on a 12-in. by 18-in. wooden frame. The telephone receiver was 200 ohms. By climbing the poles and holding the exploring coil alongside the conductor it was possible to tell by the absence of the tapping sound whether the fault was beyond the point explored. Since much of the d.c. system was networked with two mains on streets about eight blocks apart and eight or nine alley runs being tied solidly from main to main, there was some skepticism. The tone could be heard, however, with varying intensity all over the networked area, so it became a matter of locating the defective service or loop by a process of elimination.

Trouble was found in the fourth alley investigated and, when run down, was located in a nine-story office building.

• • •

Detect Coal Stoppage at Three Locations

WARNING SYSTEM indicates and identifies location of trouble in coal supply line. Arching of coal in chute (a) causes rod and tilt tube to drop, sounding horn and operating center light on boiler gage board (b). Top and bottom lights indicate trouble on weight scale or mill. There are two pulverizing mills per boiler

CYRIL BLAZING
Chief Engineer, Dubuque Plant
Interstate Power Co., Dubuque, Iowa

Stoppage of coal at any one of three key points on its route from bunker to boiler at Dubuque station of Interstate Power Co. sets off both visual and audible signals in the boiler room. These three points where warning is initiated are the coal scale, the shute leading to the feeder supplying the pulverizing mill and the pulverizing mill itself.

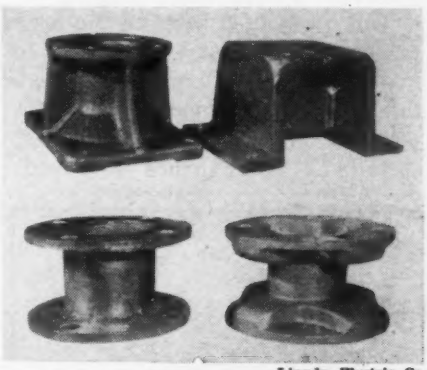
The Seco coal scales at this plant are provided with a mercury tilt tube arranged to close a timer circuit each time the weight scale dumps. If for any reason coal fails to flow down and start filling the hopper for another cycle within a certain interval after dumping, an alarm is sounded and an annunciator light on the boiler gage board indicates the scale in trouble.

Below the weigh scale in the chute leading to the feeder supplying the pulverizing mill, coal occasionally arches over, particularly when wet, cutting off the flow. To detect this source of trouble a $\frac{1}{2}$-in. rod has been thrust through the chute wall. A bell crank type of follower bearing on this rod carries a tilt-tube. When stoppage of coal flow allows the outboard portion or the rod to overbalance the portion inside the chute, it tips down bringing with it the follower. The tilt tube closes the alarm circuit, warning the operator and identifying the chute.

Over-current relays on the Raymond pulverizing mill motor supply circuit initiate similar warnings in the event of trouble from that quarter and will stop fuel flow to the mills in case the mill motors are overloaded.

•

Insulator Brackets Now Welded, Were Cast



Lincoln Electric Co.

INSULATOR holding brackets. Welded design (top right) replaces former cast bracket (left). Absence of recessed holes in welded bracket (bottom left) permits easier assembly of bolts than former cast design (right)

Simplicity and ease of designing small parts in welded steel was strikingly illustrated recently when the Delta-Star Electric Co., Chicago, found itself without necessary brackets for holding insulators on equipment for high-voltage and high-current electrical distribution systems.

The brackets being used were cast malleable iron and inability to secure satisfactory quantities caused the engineers to think of a redesign, according to a report received by The Lincoln Electric Co., Cleveland, Ohio. In a short time Delta-Star had replaced the cast brackets with welded steel brackets, making in each case a small saving in weight and cost reductions of from 20 to 35 percent.

Assembly Time Reduced

In addition, on one bracket they reduced assembly time because the welded bracket had no recessed holes which on the cast brackets had made it difficult to tighten the bolts.

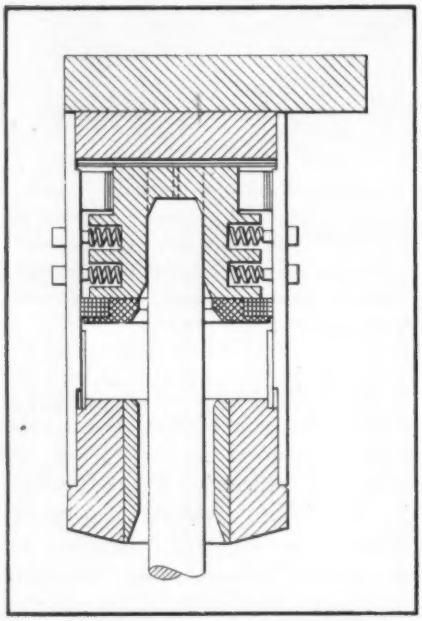
For quick action the welded redesigns were fairly close reproductions of the original cast brackets, and design improvements using lighter sections are being considered for the next lots of welded brackets.

Arc Quenching Chamber Ups O.C.B. Capacity

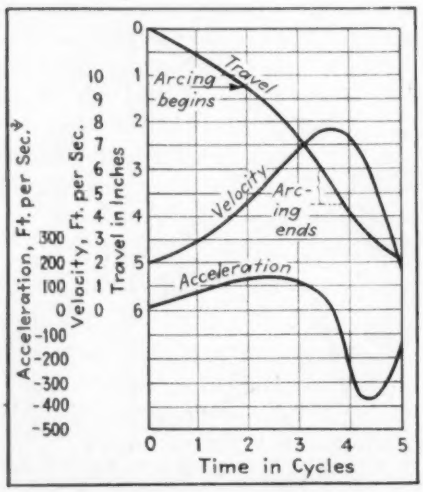
A. R. MILLER
Development Engineer
Roller-Smith Co., Bethlehem, Pa.

Good conduction and high capacity per cubic inch of space were aims in deciding upon the use of a new arc quenching chamber in a new series of oil circuit breakers. Another objective was to reduce the internal tank pressure.

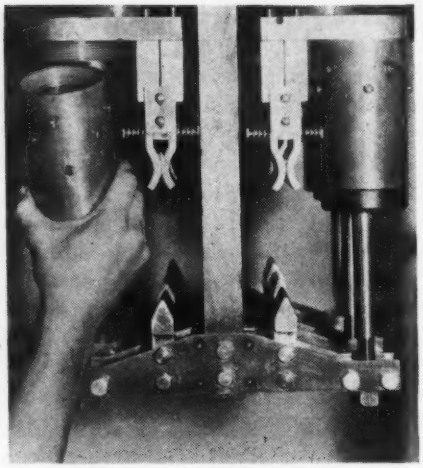
This quenching chamber is a brass cylinder which contains a nest of female arcing contacts. One end is threaded for attachment to the support; the other is capped with a Micarta ring with orifice sufficiently large to receive the male arcing contact.



CUTAWAY VIEW of quencher



CURVES, which were derived from oscillograms, show acceleration and velocity of male contact at various positions and the points at which arcing begins and ends



QUENCHING CHAMBER on left is being replaced after inspection. The chamber on the right is in position and has the male contact inserted

The arc extinction is accounted for by a principle termed "Exotherm." It is based on the fact that, as the temperature of a gas increases, its conductivity increases (but not linearly); also, as the pressure of a gas increases, its conductivity decreases. Any arrangement whereby the heat of an arc can be extracted tends to make the arc medium non-conducting, and thereby quenches the arc.

In this chamber such cooling is accomplished by bringing the arc intimately in contact with the oil; at current zero it is intended to have the hot gases so disposed that a maximum of heat will be transmitted away and consequently raise the dielectric strength to a point where the arc is quenched as the current wave passes through zero.

At this same time, the high pressure inside the quencher assists in the process. The arc causes the pressure to rise and consequently decreases the conductivity of the gas. It also greatly accelerates the travel of the male contact. Both have cumulative effects in shortening the overall arcing time.

There is also a secondary effect which takes place outside of the quencher due to the fact that the gases, which are generated in the enclosure, expand through the body of oil and are thereby cooled and condensed. This relieves the maximum tank pressures to approximately 40 psi. Another related factor is, since the volume of gas is reduced, less space internally is required between adjacent phase parts of the oil circuit breaker.

• • •

Salt Sprays Safe for Fire-Fighting

Salt water from harbors or rivers can be used for fire-fighting with practically as much security as so-called fresh water of city reservoir and pumping systems. This was demonstrated by H. F. Brown, assistant electrical engineer of the New Haven Railroad, at a recent fire chief assembly in New Haven.

Readings were taken at the nozzles from which the streams or sprays were directed at a structure (see figure) designed to simulate the 11-kv. electrification system of the railroad. The grid on which the water impinged was energized from a 5-kva. 60-cycle transformer with a 100/1 potential transformer applied to actuate the voltmeter. A six-milliampere relay was inserted to actuate the red light whenever the current to ground exceeded that value. During some of the tests the red light flickered on and off, showing occasional spurts of current back through the streams or sprays.

As can be seen from the tabulation, hardly perceptible voltage and imperceptible current were detected at the nozzle when a 1-in. Rockwood Waterfog nozzle was delivering salt-water spray from a distance of 15 feet and at a pressure of 100 psi. One test showed practically identical re-

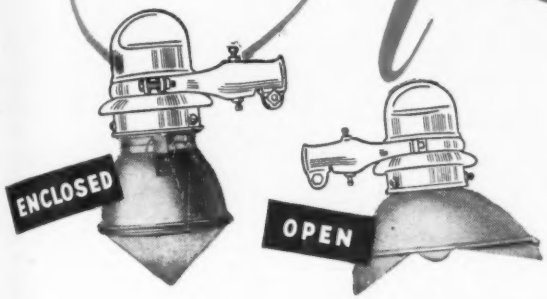
Nozzle Voltages and Currents Using Salt and Fresh Water Sprays and Streams on 11-kv. Conductors

Test	Volts kv.	Water	Stream or Fog	Pressure psi.	Diam. in.	Distance ft.	At Nozzle E	At Nozzle MA
A	11.8	Salt	Stream	55	1	15	30–50	1.0±
B	12	Salt	Fog	100	1	15	<1.5	0
C	12	Salt	Stream	40	1¼	40	<1.5	0
D	12	Salt	Stream	60–70	1¼	40	0	0
E	12	Salt	Stream	45	1¼	45	0	0
F	11.8	Fresh	Stream	60	1¼	30	0	0
G	11.5	Fresh	Stream	60	1¼	18	50–60	5±

G-E Announces

A Basic Advance in SUBURBAN STREETLIGHTING

Two new reflectors -- using 1000- to 2500-lumen lamps



These two new reflectors (open and enclosed) are the "better sight" successors to the radial-wave reflector for light-traffic and residential streets — the suburban streets.

When equipped with the new G-E 2500-lumen series lamps of 5⅛-inch light-center length and spaced as recommended, these new reflectors make it practical and economical to meet I.E.S. Standards for suburban streets.

For the first time, they bring scientific light control into the field of minimum-cost street-lighting.

Full details on these new reflectors can be obtained by calling your local G-E office. Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

Adaptable to your present hoods and insulators, they furnish greatly improved visibility as unit-for-unit replacements of radial-wave reflectors.

ARE YOU TYING IN WITH THE NEMA PLAN TO GIVE AMERICA BETTER STREET LIGHTING? REMEMBER . . .

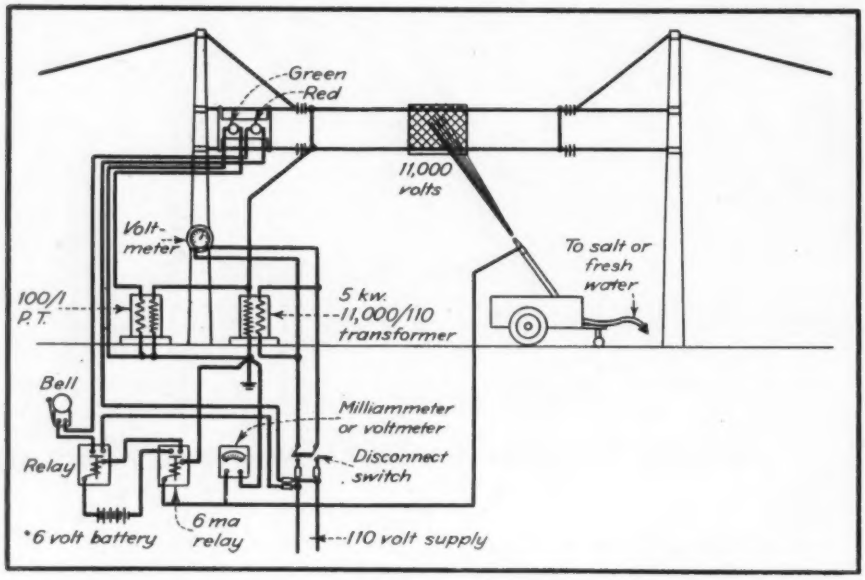
Good Street Lighting Builds Good Will!

STREET LIGHTS *for Better Seeing*

GENERAL ELECTRIC

452-58-3010

sults with a 1¼-in. stream at 40 ft. In order to decrease the effect of shunting to ground when using the salt harbor water, a 500-ft. length of hose was inserted between fireboat and nozzle.



TEST SETUP for making electrical conductivity observations with salt and fresh water sprays and streams on 11-kv. conductors. Red lamp energized by relay whenever current to ground exceeds six milliamperes. Readings were taken at nozzle

• • •

Corona Discharge of Okoprene Sheath

One of the electrical characteristics of Okoprene-covered aerial cable was determined when a test was made for the voltage at which corona would occur for both dry and wet conditions. Results of the tests together with those for braid-covered cable are given in the accompanying table. The tabulation was included in a paper, "Factors Which Influence Aerial Cable Design and Operation," by Robert J. Wiseman, Chief Engineer, The Okonite Co., Passaic, N. J., presented recently before the Transmission and Distribution Committee of the Edison Electric Institute. This is an addition to discharge current data presented in ELECTRICAL WORLD, November 24, 1945, page 112.

The corona test values show that the Okoprene-covered cables require a higher voltage to cause corona and there is only a moderate decrease in required voltage for a wet surface as compared to a dry surface. For a braid covering, the wet surface causes a decrease of 50-70 percent, in the voltage to cause corona, from that for a dry surface. In the case of braided cables this corona voltage can be lower than the operating voltage.

These results indicated that a rubber-insulated cable with an Okoprene covering over the insulation should have a longer life in service than a braid-covered cable. To prove that this is so, cables with both kinds of covering were installed in the company's Proving Grounds and 7,500 volts applied between the conductors on a 4,150-volt design. The braid-covered cables show evidences of the braid rotting away in five years and testers found the braid burnt away under the cable ring with corona cutting having started, while the Okoprene covering after five years showed no signs of any weathering or electrical damage. Until further experience is obtained, the Okonite Co. is limiting the operating voltage to 5 kv. for these Okoprene-covered cables which are being manufactured.

Visual Corona: Fibrous vs. Okoprene-Sheathed Cables Insulated for 5-Kv., 3-Phase—Volts to Ground

Item	No. 1 AWG Fibrous Covered, volts	No. 1 AWG Okoprene Sheath, volts	350,000 cm. Okoprene Sheath, volts	4/0 AWG Fibrous Covered, volts
Cables Tested Dry				
Corona Discharge Appeared	3,300	4,600	5,000	4,300
Corona Discharge Disappeared	2,800	4,100	4,200	2,800
Equivalent Phase Voltage	5,720–4,850	7,970–7,110	8,660–7,270	7,450–4,850
After 24 Hours Immersion				
Corona Discharge Appeared	1,800	4,400	4,800	1,300
Corona Discharge Disappeared	1,000	4,000	3,900	850
Equivalent Phase Voltage.....	2,130–1,730	7,630–6,930	8,310–6,750	2,250–1,470

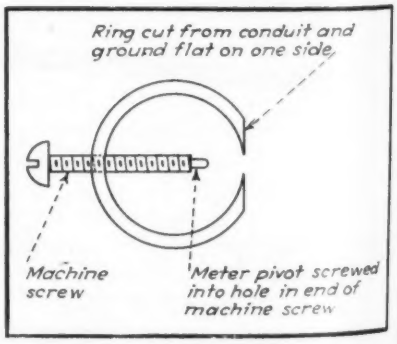
•

Identify Leads on Switchgear Diagrams

A correction for the simplified wiring diagram, Fig. 1, with article "A Method for Identifying Leads on Switchgear Wiring Diagrams," in ELECTRICAL WORLD, October 27, 1945, page 110. Dots should not have appeared at the apparent junction points in the schematic method of indicating the combining and the branching out of several leads embraced in a group or trunk indicated for simplicity in representation. These dot symbols, customarily employed to indicate the joining of conductors, were not on the drawing received and are erroneous in the reproduction.

•

Gear Puller Developed for Clock Rotors

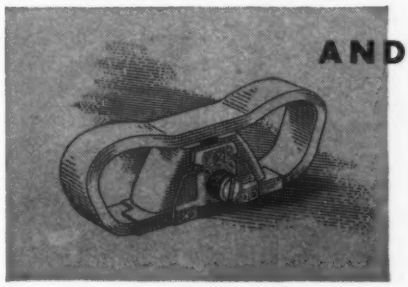


A HANDY GEAR puller for clock rotors and other gear trains has been made up by A. E. Owens of the Kansas Gas & Electric Co., Wichita, as shown, from a short piece of conduit ground flat on one side, a machine screw and a meter pivot. Assistant meter foreman Owens at Wichita uses several gear pullers of this type, each made from different sizes of conduit, thereby enabling him to pull different sizes of gears

You can count on the

I-30

FOR MAGNETIC STABILITY



AND NO WONDER! At the heart of this meter is a G-E alnico magnet

This surge-resisting magnet owes its stability to (1) all-welded, one-piece construction, (2) careful control of material and dimensions at every step in manufacture, and (3) the inherently high coercive force of alnico. It helps make the I-30 a meter you can depend upon—a meter that maintains its excellent performance under increasing loads in both urban and rural service.

Include the I-30 in your metering program. It's the safe thing to do. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

WATTHOUR METERS

Headquarters for Electrical Measurement

GENERAL ELECTRIC

501-15-4110

A Method to CALCULATE FAULT CURRENT

TRANSFORMERS			SECONDARY LOOP			
3-Phase Rating, kva	Z %	I_s Short-Circuit Amp.	Capacity %	Cable Size Type RH or V, AWG. or Mcm.	Single-Conductor Cables Per Phase	Z_M/Z_T* Ratio per 100 ft. of Loop
208-VOLT, 3-PHASE, 60-CYCLE, NETWORK SYSTEM						
150	5.0	8,320	67	1/0	2	0.444
150	7.0	5,940	67	1/0	2	0.317
150	9.0	4,620	67	1/0	2	0.247
150	5.0	8,320	100	4/0	2	0.250
150	7.0	5,940	100	4/0	2	0.178
150	9.0	4,620	100	4/0	2	0.139
200	5.0	11,100	67	3/0	2	0.397
200	7.0	7,930	67	3/0	2	0.284
200	9.0	6,170	67	3/0	2	0.221
200	5.0	11,100	100	300	2	0.257
200	7.0	7,930	100	300	2	0.184
200	9.0	6,170	100	300	2	0.143
300	5.0	16,660	67	300	2	0.386
300	7.0	11,900	67	300	2	0.276
300	9.0	9,260	67	300	2	0.215
300	5.0	16,660	100	600	2	0.270
300	7.0	11,900	100	600	2	0.193
300	9.0	9,260	100	600	2	0.150
500	5.0	27,760	67	350	3	0.390
500	7.0	19,830	67	350	3	0.279
500	9.0	15,420	67	350	3	0.217
500	5.0	27,760	100	500	4	0.243
500	7.0	19,830	100	500	4	0.173
500	9.0	15,420	100	500	4	0.135
750	5.0	41,640	67	500	4	0.364
750	7.0	29,740	67	500	4	0.260
750	9.0	23,130	67	500	4	0.203
750	5.0	41,640	100	600	5	0.271
750	7.0	29,740	100	600	5	0.194
750	9.0	23,130	100	600	5	0.151
460-VOLT, 3-PHASE, 60-CYCLE, NETWORK SYSTEM						
300	5.0	7,540	67	1	2	0.224
300	7.0	5,390	67	1	2	0.160
300	9.0	4,190	67	1	2	0.124
300	5.0	7,540	100	3/0	2	0.122
300	7.0	5,390	100	3/0	2	0.087
300	9.0	4,190	100	3/0	2	0.068
500	5.0	12,560	67	4/0	2	0.170
500	7.0	8,970	67	4/0	2	0.121
500	9.0	6,980	67	4/0	2	0.094
500	5.0	12,560	100	400	2	0.111
500	7.0	8,970	100	400	2	0.080
500	9.0	6,980	100	400	2	0.062
750	5.0	18,820	67	400	2	0.167
750	7.0	13,440	67	400	2	0.119
750	9.0	10,460	67	400	2	0.093
750	5.0	18,820	100	400	3	0.111
750	7.0	13,440	100	400	3	0.079
750	9.0	10,460	100	400	3	0.062
1000	5.0	25,100	67	600	2	0.183
1000	7.0	17,930	67	600	2	0.131
1000	9.0	13,940	67	600	2	0.102
1000	5.0	25,100	100	600	3	0.122
1000	7.0	17,930	100	600	3	0.087
1000	9.0	13,940	100	600	3	0.068
1500	5.0	37,720	67	600	3	0.183
1500	7.0	26,940	67	600	3	0.131
1500	9.0	20,960	67	600	3	0.102
1500	5.0	37,720	100	500	5	0.119
1500	7.0	26,940	100	500	5	0.085
1500	9.0	20,960	100	500	5	0.065

*Z_M/Z_T ratio for any other length of loop between adjacent transformers is directly proportional to the loop length between adjacent transformers.

Tables and graph give data for determining the total instantaneous symmetrical 3-phase bolted fault current for a fault on any load (secondary) bus. An example is included on the adjacent page.

By JOHN S. PARSONS
Distribution Engineer, Westinghouse Electric Corp., East Pittsburgh, Pa.

Method for calculation is applicable where the network system uses the same rating transformers throughout and the length of the secondary loop between adjacent transformers is approximately the same.

Data tabulated here includes:

(1) Instantaneous symmetrical fault currents, I_T, for a bolted 3-phase fault on the secondary terminals of transformers of various kva. rating and impedance, with sustained voltage on their primary terminals. The term "bolted fault" means a fault having zero impedance.

(2) Number and size of cables recommended for the secondary loop.

(3) The ratio, secondary loop impedance between adjacent transformers, Z_M, for a 100-ft. leng h of loop divided by the impedance of a transformer, Z_T, is given for the various transformers. This ratio, Z_M/Z_T, is an index on a graph from which can be determined the short-circuit current.

Tabulated data are references for the graph from which can be determined the C ratio and then the total fault current for a fault on a secondary load bus.

AN EXAMPLE

FIND: Instantaneous symmetrical short-circuit currents, *I*, for a bolted fault on one of the load buses of a 460-volt secondary network system having six transformers. Each transformer is rated 750 kva., 3-phase and has 7.0 percent impedance. Secondaries of the transformers are tied together by a 67 percent capacity secondary loop, which consists of two 400,000 cir. mil. single-conductor, type RH or V cables per phase. Length of the secondary loop between adjacent transformers is 250 ft.

SOLUTION: From Table II, I_T is 13,440 amp. and Z_M/Z_T ratio for 100 ft. of loop between adjacent transformers is 0.119. Z_M/Z_T for the system is 2.5 × 0.119 or 0.298. From the curves for six transformers and a Z_M/Z_T ratio of 0.298, the C ratio for the system is 2.55.

Total fault current is:

$$I = I_T \times (C \text{ ratio} + 1)$$

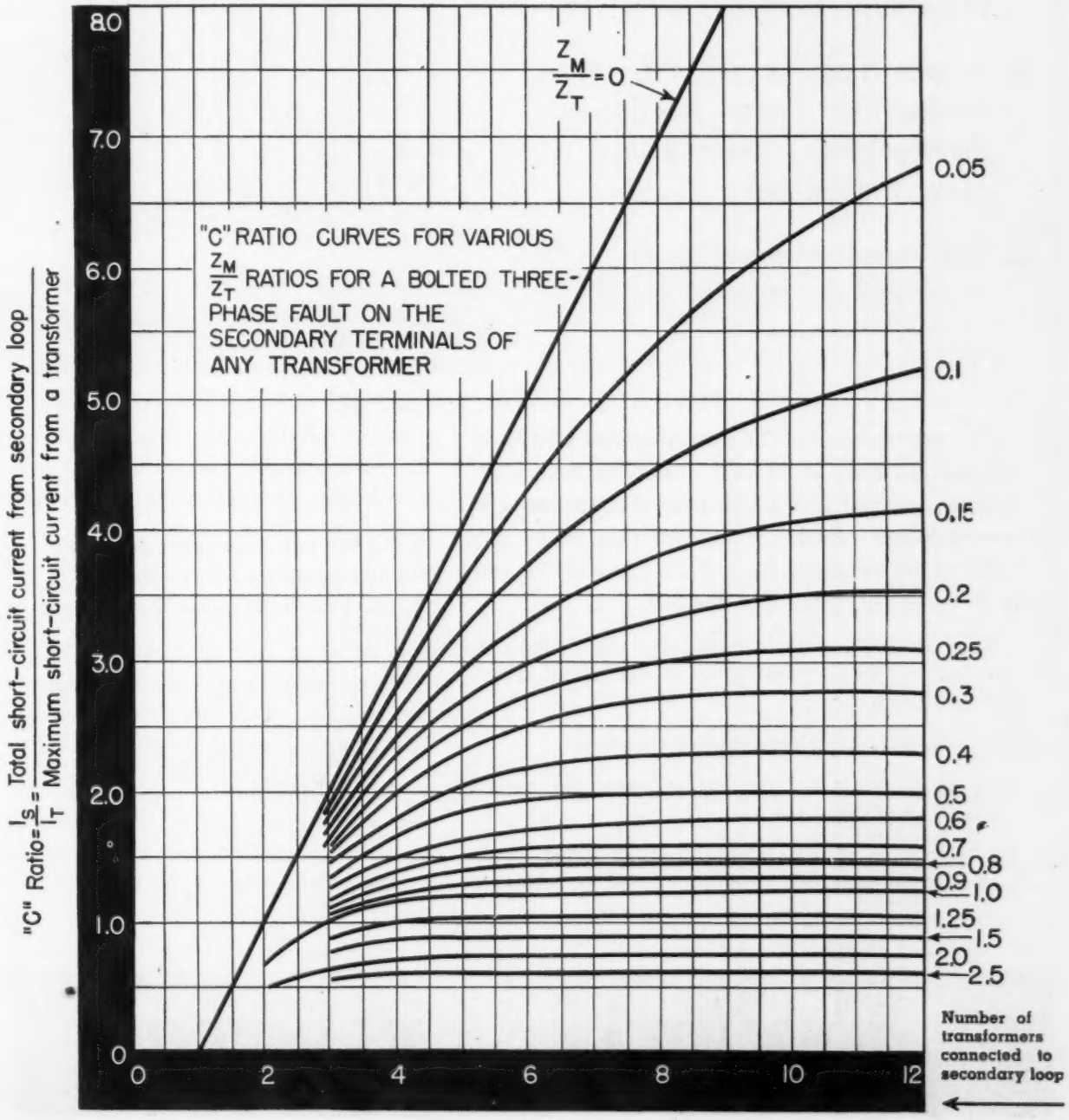
and by substituting in the equations, $I = 13{,}440 \times (2.55 + 1) = 47{,}710$ amp.

This value of fault current is based on sustained voltage on the primary side of all network transformers. In most cases the impedance of the primary feeders is negligible. The supply system impedance, however, may be appreciable, and where it is, should be taken into account. This may be done in the following manner.

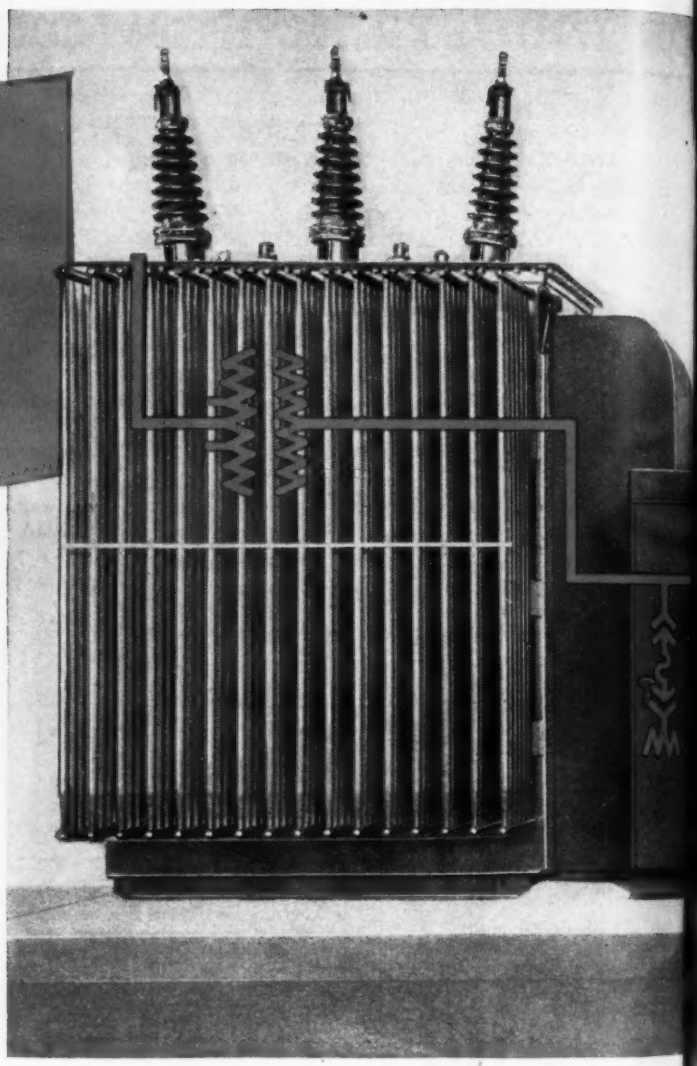
Assume that the maximum fault on the supply bus of the primary substation feeding the network system is 120,000 kva. An equivalent impedance for the network transformers and secondary loop in percent on the kva. rating of one of the transformers is 941 amp., the full load current of a 750-kva., 460-volt transformer, divided by 47,710 amp. and multiplied by 100, or 1.97 percent. Impedance of the supply system in percent on the same 750-kva. base is 750 divided by 120,000 kva., and multiplied by 100, or 0.625 percent. This impedance is added in series with the network system impedance giving a total of 2.595 percent impedance on 750 kva.

Corrected short-circuit current for a bolted fault on a network load bus is 100 divided by 2.595, and multiplied by 941, or 36,250 amp. total fault current. In this case the inclusion of the supply system impedance results in a very appreciable reduction in the maximum total current into a bolted fault on a network load bus.

This simplified method is applicable, with very little change in its accuracy (± 5 percent max.), where the spacings between adjacent transformers connected to a loop do not vary more than two to one if the average spacing between transformers is used.



NOW 3 more BUILT-IN FUNCTIONS



1. **Individual feeder regulation**
2. **By-pass facilities for the feeder breakers, the current transformers, the regulating equipment, and the power transformers**
3. **Two complete power-supply paths to each of the outgoing feeders**

This new master DUPLEX unit substation affords increased flexibility as to both substation design and function, together with a high degree of continuity of service. Where individual feeder regulation and by-pass facilities are required, the DUPLEX provides the way to do the job at remarkably low cost.

The DUPLEX unit is especially well suited to locations where continuity of service is of prime importance, because:

- **It is completely automatic in operation**
- **Its operation is not dependent upon the correct operation of other units**
- **It is capable of maintaining, through either transformer, the total load normally carried by both**

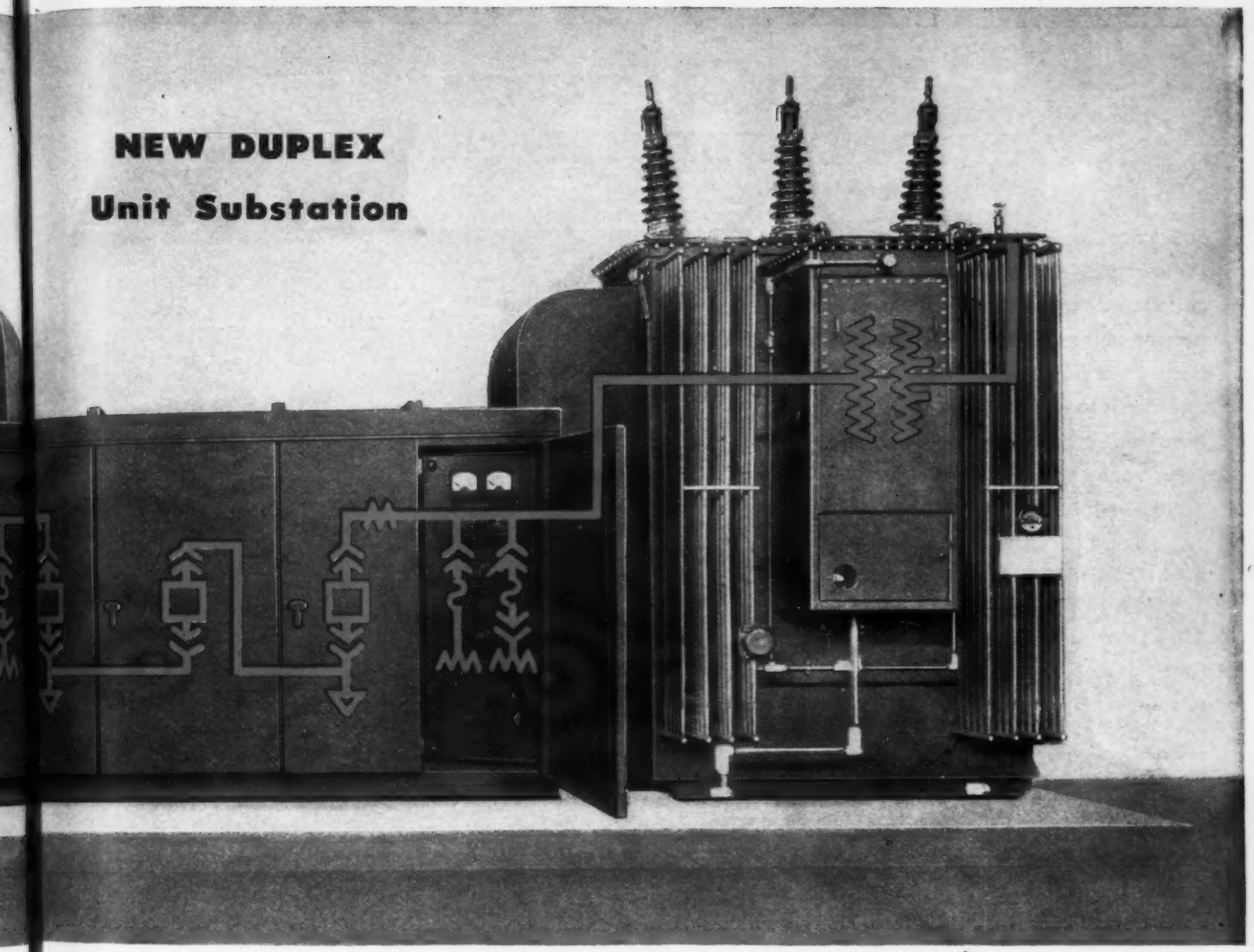
Don't overlook the fact that the DUPLEX is a standard G-E unit substation. Your over-all installed cost is low, and it is definitely predictable, because:

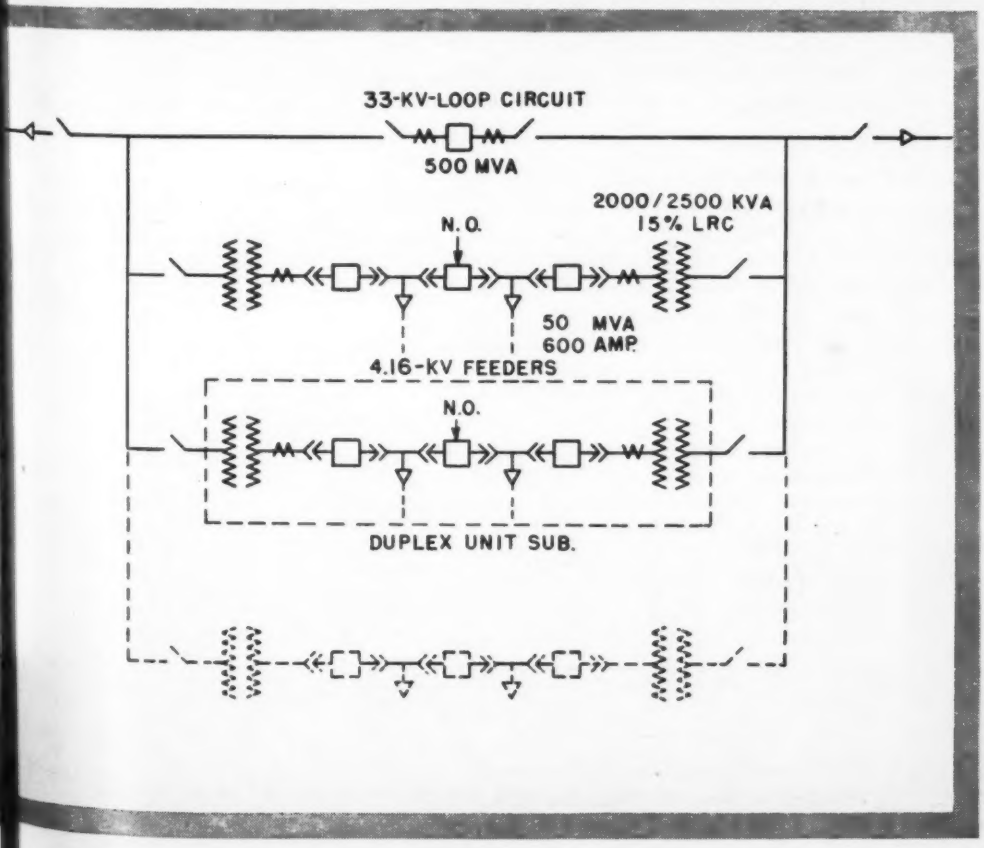
- **The DUPLEX is standard equipment**
- **It is repetitively manufactured**
- **It is completely assembled for you at the factory**

The DUPLEX unit substation can be used separately or in conjunction with identical units to make a substation with a total capacity as large as 20,000 kva. It is compact, easy to install, and easy to move.

Your local G-E sales engineer will be glad to give you further information. Ask him for a copy of Bulletin GEA-4478. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC





Relaying is so arranged that, if voltage disappears at the secondary of one transformer, the breaker on that side immediately opens and the tie breaker automatically closes, restoring service in approximately 105 cycles.

The DUPLEX provides a "building block" approach to the construction of standard substations which have a degree of operating flexibility heretofore obtained only by special engineering and construction. Small or large substations can be economically made up of the same basic unit. A single DUPLEX unit can be installed at first, and as the load grows, additional units can be added when they are needed.

UNIT SUBSTATIONS

VECTOR ANALYSIS OF SCOTT-CONNECTED TRANSFORMER

Current and voltage relations in the various branches of a Scott-connected transformer and the proper relay differential connections in order to protect the bank against internal faults can be determined by means of a step-by-step vector analysis at various points in the transformer circuits.

JOSEPH M. DeGUILMO
Substation Department, Public Service Electric & Gas Co., Jersey City, N. J.

The Scott-connection is a scheme by means of which a 3-phase to 2-phase (or vice versa) transformation may be secured with the use of only two transformers. One of these transformers, known as the "main," is provided with a 50 percent tap and the other, known as the "teaser," has an 86.6 percent tap. Because of the peculiar connection of the windings of these transformers, the application of differential relay protection to a transformer bank of this type is somewhat of a problem.

To begin an analysis of this problem refer to Figure 1. I_1, I_2, and I_3 are three equal line currents which flow in the 3-phase side of the bank. I_1 flows through the primary of the teaser transformer, out of the 86.6 percent tap and enters the main transformer at point D. At this point, I_1 divides; $\frac{1}{2}I_1$ goes toward point 3 and the other $\frac{1}{2}I_1$ goes toward point 2 of the main transformer, I_2 and I_3 combined with I_1 in this winding.

Fig. 2 shows vectorially the system voltages, the line currents and the components of the latter. It also shows the main and teaser secondary currents.

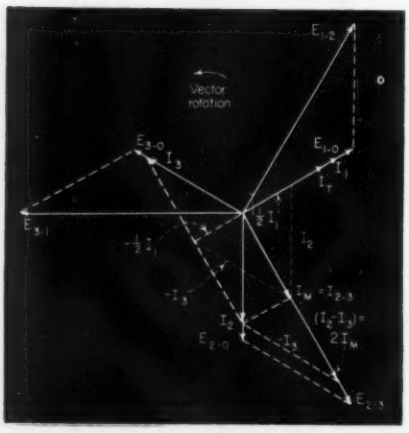


Fig. 2—Voltage and current vectors

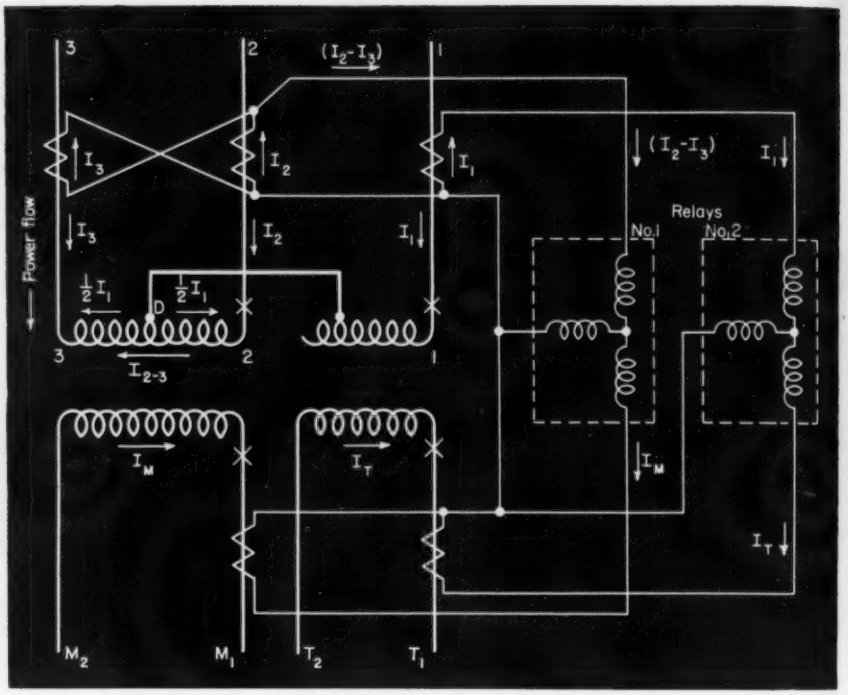


Fig. 1—Current flow in transformers and in differential relays

Analysis of the teaser transformer shows that the secondary current I_T will be equal to 0.866 I_1 and in phase with it. In the current transformers of this transformer these currents will flow as shown in Fig. 1 and will circulate through the restraining coils of the differential relay No. 2, causing the relay to remain open for power flow through the transformer. The proper choice of current transformers must be made so that the secondary currents I_1 and I_T will be equal. If necessary, auxiliary autotransformers must be installed in the circuits to balance these two currents.

An analysis of the currents in the main transformer is more complicated. The secondary current I_M is equal to and in phase with I_{2-3} in the primary (a 1:1 ratio is assumed). Applying Kirchoff's first law—the sum of the currents at any point equals zero, —

At point 3:

$$\frac{1}{2}I_1 + I_3 + I_{2-3} = 0$$

$$I_M = I_{2-3} = -\frac{1}{2}I_1 - I_3$$

This construction is carried out in Fig. 2 and gives the vector position of I_M as lagging I_T by 90 deg.

At point 2:

$$\frac{1}{2}I_1 + I_2 - I_{2-3} = 0$$

$$I_M = I_{2-3} = \frac{1}{2}I_1 + I_2$$

This construction in Fig. 2 gives the same result for I_M as the analysis at point 3.

Again referring to Fig. 1, No. 1 differential relay has I_M leaving one restraining coil and a current $(I_2—I_3)$ entering the other. It is now necessary to find the relationship between these two currents.

$$I_2 = -\frac{1}{2}I_1 + I_M$$

$$I_3 = -\frac{1}{2}I_1 - I_M$$

$$\therefore I_2 - I_3 = 2I_M$$

This algebraic solution is vertified by the graphical construction in Fig. 2. These two unequal currents will have to be balanced by the correct choice of current transformers and perhaps by the use of auxiliary autotransformers.

A final check of the results:

$$I_1 = \frac{I_T}{0.866}$$

$$I_2 = -\frac{1}{2}I_1 + I_{2-3} = -\frac{1}{2}\frac{I_T}{0.866} + I_{2-3}$$

$$I_3 = -\frac{1}{2}I_1 - I_{2-3} = -\frac{1}{2}\frac{I_T}{0.866} - I_{2-3}$$

$$\therefore I_1 + I_2 + I_3 = 0$$

G-E offers 2 Types of UNDERFLOOR WIRING

G-E FIBERDUCT
(For concrete and wood floors)

Here G-E Fiberduct underfloor raceways are being installed. Note grid layout to serve outlets.

G-E Q-FLOOR WIRING
(For Robertson Q-Floors)

Here G-E Q-Floor Wiring feeder header ducts are being installed. Floor cells act as raceways to serve outlets.

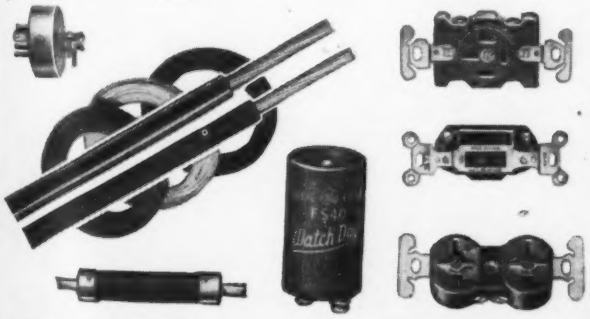
These underfloor electrical distribution systems are ideal for factories, office buildings, stores, etc. Both G-E Fiberduct and G-E Q-Floor Wiring give complete electrical flexibility to the buildings in which they are installed. Electrical outlets can be preset or added later as needed.

All machines, telephones, signal devices, etc., can be changed at will with the assurance that power will be available in the new locations. Imagine how flexible these underfloor wiring systems make buildings. Floor space is always available for new uses. What is more, every bit of space can be used efficiently.

FOR FURTHER INFORMATION on G-E Fiberduct underfloor raceways and G-E Q-Floor Wiring or on G-E wires and cables and G-E wiring devices see the nearest G-E Merchandise Distributor or mail the coupon.

G-E Building Wires and Wiring Devices

G-E building wires and wiring devices will meet every requirement. In the G-E line are Types T and TW Flamenol* Building Wires, other building wires and hundreds of wiring devices including switches, outlets, lampholders, fuses, fluorescent lamp starters, etc.



*Reg. U.S. Pat. Off.

General Electric Co.
Section CDW1259-9
Appliance and Merchandise Dept.
Bridgeport, Conn.

Sirs: Please send me: ☐ G-E Fiberduct catalog; ☐ G-E Q-Wiring catalog; ☐ Information on G-E wires and cables and wiring devices.

Name .....

Address .....

City ..... State .....

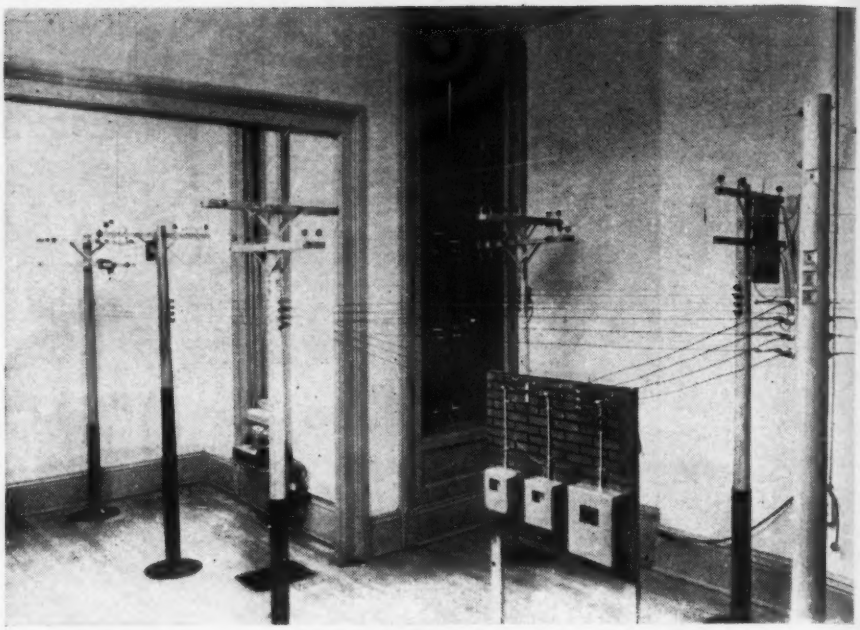
GENERAL ELECTRIC

Linemen Trained on Model Line

A. W. CHEWNING
Overhead Line Dept.
The Detroit Edison Co., Detroit, Mich.

As a supplement to "on the job training" of linemen, The Detroit Edison Co. uses an operating model of a distribution line to actually duplicate the electrical indications for normal and trouble conditions that students will encounter later in the field. On it, trouble cases, such as "opens," improper rotation or abnormal voltages, can be set up and given to a lineman for analysis and correction.

With the model the apprentice lineman can concentrate during training on the tests and signals without exposure to high voltage or distraction due to position on the pole. Later, on the job, he has enough knowledge so that he can pay proper attention to position, footing and movement on the pole in addition to testing. Moreover, the model permits reproduction of conditions not permissible in the field, such as grounding of primary circuits.



SIX-VOLT OPERATING MODEL of distribution line used in training linemen. Note panel mounting models of two, three and four-wire meter boxes.

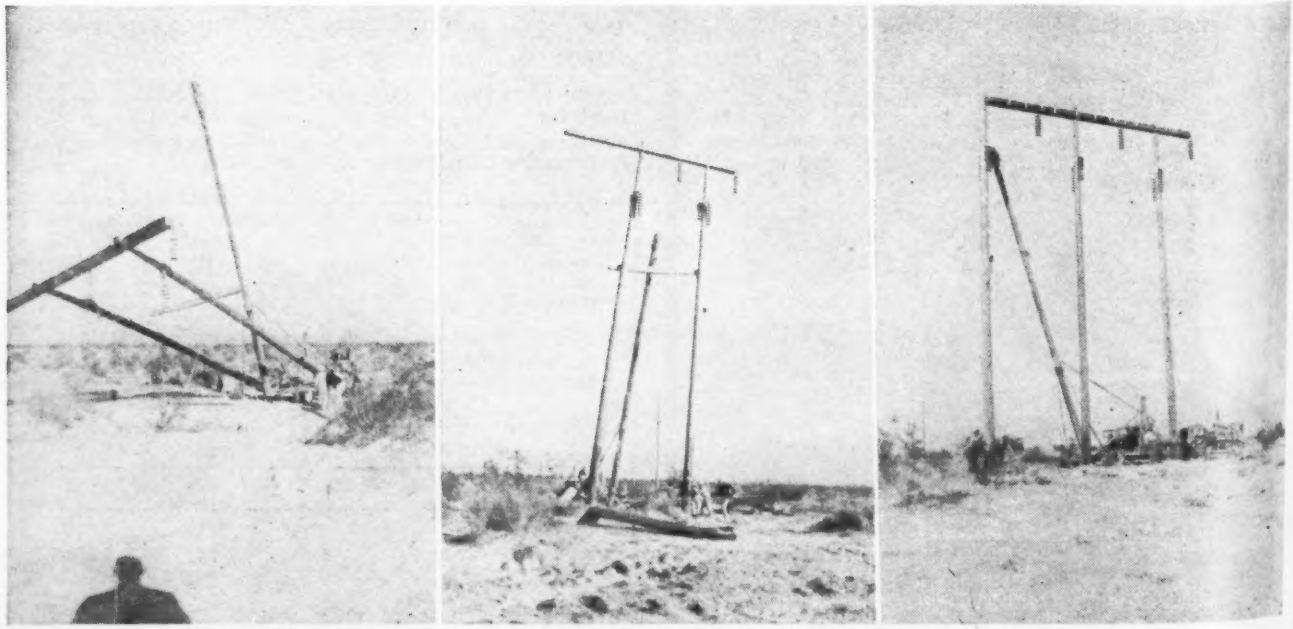
Operating primary and secondary voltage of the model is six volts, three-phase. Energy source is 240-volt three-phase (or 208-volt from the network) stepped down by a small transformer to 6 volts and led to one of two cable poles of the line. Each cable pole is fed from a separate transformer to duplicate the field condition of circuits fed from different substations.

One cable pole supplies a primary "ring," providing an opportunity to do phasing and operating on rings. The other supplies two spans of three-phase primary that deadened on a buckarm pole of the primary ring. This provides an opportunity to phase between different circuits, between a grounded primary (Detroit's is an ungrounded delta system) and ungrounded primary or between two grounded circuits. A primary phasing set was built to give dim and bright indications the same as set used in the field.

Secondaries of the model run on four-wire racks. They are fed by

• • •

Trailer-Mounted Boom Saves Construction Time



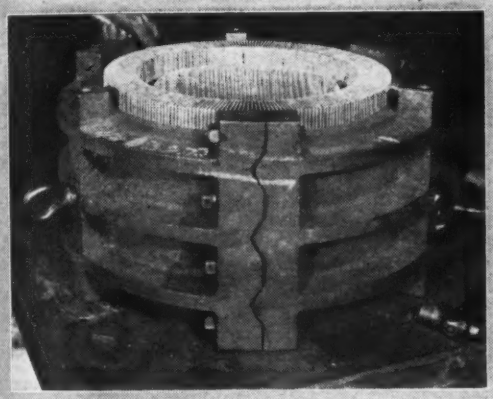
ONE OF THE LABOR SAVING METHODS used in building a 92-kv. line in the Imperial Valley was use of a trailer mounted boom. H-frame structures were completely framed on the ground and set as a unit. The L. H. Leonardi Electric Construction Co. of Los Angeles was contractor on the line. Three steps in the erection of one structure are illustrated

FOR COMMUTATOR BARS

SEE REVERE

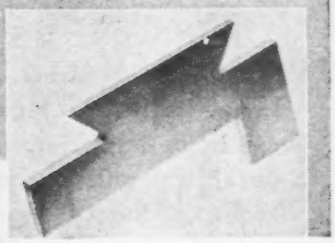
1. *Smoothing bar before assembly. Revere can save you this operation*

Illustrations (1 to 6) show some of the steps in assembling a commutator

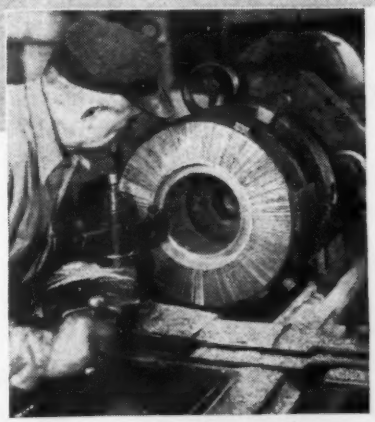


2. *Bars and mica assembled in clamp*

3. *Checking alignment after baking*



Typical segment from Revere



4. *Finishing front and back Vs*

REVERE does not make commutators but furnishes commutator copper as you require it—in lengths of the proper cross section, ready for cutting, or in segments ready for assembly without further processing. The metal may be Electrolytic Copper, Oxygen-Free High Conductivity Copper, or one of the Silver-Bearing Coppers, depending upon conditions of service. In some applications, the trend toward smaller size and higher speed requires special care in selection of the metal. Consult Revere.

REVERE

COPPER AND BRASS INCORPORATED

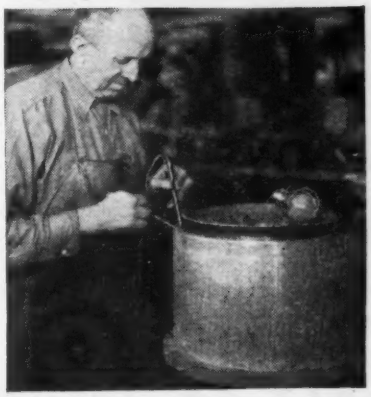
Founded by Paul Revere in 1801

230 Park Ave., New York 17, N.Y.

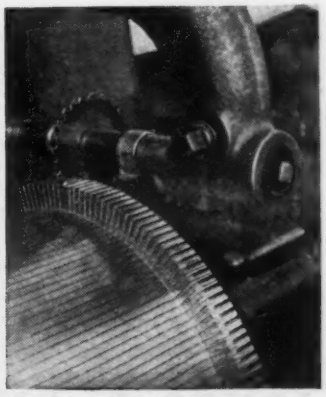
Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N.Y.

Sales Offices in principal cities, distributors everywhere

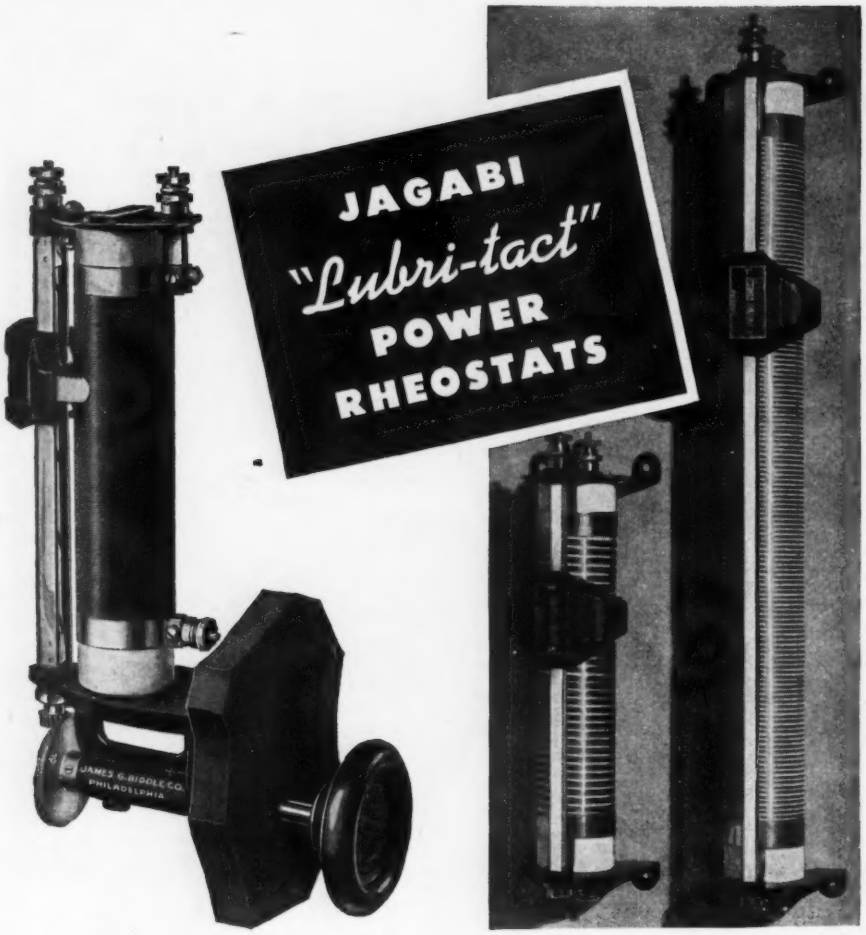
Listen to Exploring the Unknown *on the Mutual Network every Sunday evening, 9 to 9:30 p.m., EST*



5. *Checking for shorts*

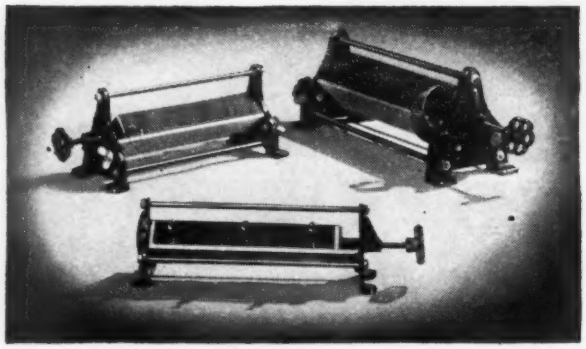


6. *Slotting the "ears." Revere can supply bars ready slotted*



Whether for direct manual adjustment or for front-of-board control, Jagabi "Lubri-tact" Power Rheostats can be depended upon to do a real job where ruggedness, durability and maximum heat-dissipating qualities are required. Suitable for either d-c or a-c control in 4 sizes and 76 ratings from 30,000 ohms, 0.1 amp. to 1.6 ohms, 25 amps. Available in screw-driven fine adjustment types, and with metal cages, multiple sliders and other modifications.

Write for Bulletin 1745-W.

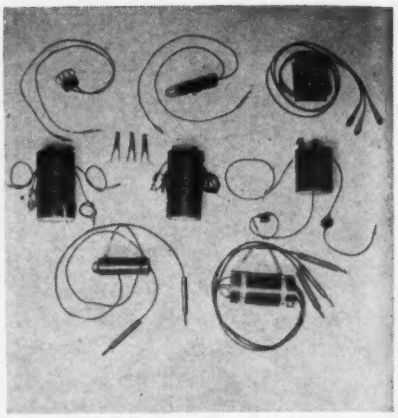


"JAGABI"
COMPRESSION
CARBON
RHEOSTATS

Jagabi Compression Carbon Rheostats can be smoothly controlled by screw adjustment, and overloads of several hundred percent are permissible for short periods of time. Four sizes in current ratings from 6 to 65 amps. up to 55 to 800 amps.

Write for Bulletin 1745-W.

JAMES G. BIDDLE CO. 1211-13 ARCH STREET PHILADELPHIA 7, PA.



OPERATING ACCESSORIES permit simulation of field tests on three-phase six-volt model of distribution line

Top row (left to right); secondary test set, push-button secondary test set, secondary rotation set. Middle row; single-phase distribution transformer, phase marker pins, single-phase distribution transformer for open-delta installation, booster transformer. Bottom row; primary test set, primary phase rotation set

1:1 transformers that can be hung on crossarms and clipped to primaries. Single phase, open-delta, and closed-delta installations can be made. Operating models of primary and secondary phase-rotation indicators have been built so the power transformer of an open-delta bank can be connected to the lagging phase, as required in the field. Model secondary test sets give indications on secondary conductors as in the field.

A simulated brick wall panel mounts two, three and four-wire outdoor meter boxes with service out-

These Operations Can Be Performed

Primary

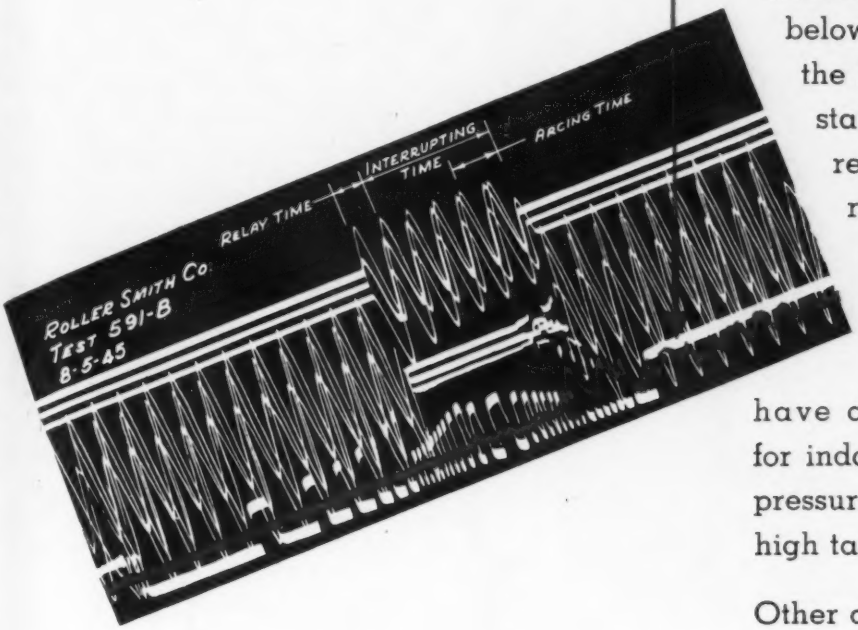
1. Phasing two circuits fed from same transformer bus.
2. Phasing two circuits fed by different substations.
   a. Each circuit normal.
   b. One circuit grounded—other circuit normal.
   c. Each circuit grounded—same phase.
   d. Each circuit grounded—different phase grounded on each circuit.
   e. One circuit fed from a wye-delta substation and other circuit fed from a delta-delta substation.
3. Phasing to close primary ring.
4. Check circuit for normalcy.
5. Installation of single phase booster.
6. Tests with back-feed.
7. Tests for faults.
8. Test for proper phase rotation.

Secondary

1. Phase line secondaries.
2. Test for connecting service drops to 2, 3, and 4-wire meters.
   a. Without load.
   b. With meter load.
   c. With customer load.
3. Phase transformer secondary with line secondary to add transformer to a secondary bank.
4. Check secondary for normalcy.

PRINCIPLE

of Low Tank Pressures



TANK PRESSURE—Typical test oscillogram of Roller-Smith oil circuit breaker at full rated capacity—note slight fluctuation in tank pressure.

THE Roller-Smith Exotherm principle of arc extinction confines the heated gases in an arc chamber. The arc is extinguished by the combination of internal pressure and lowered gas temperature.

By harnessing the gas pressure within the quencher, the pressure in the tank itself remains at a nominal value well below any danger point. Every test at the Roller-Smith "On the Line" test station includes the tank pressure reading along with voltage, current and time. Average tank pressures do not exceed 40 pounds per square inch.

Exotherm oil circuit breakers have a far greater factor of safety for indoor use as a result of the low pressure than breakers with the usual high tank pressures.

Other advantages of the new Exotherm principle are: 5 cycle operation; reduced contact burning; reduced maintenance and inspection; more consistent arc performance.

For full information on the Exotherm principle applied to Roller-Smith oil circuit breakers, write to dept. EW-6.

ROLLER SMITH

ROLLER SMITH

Oil Circuit Breakers

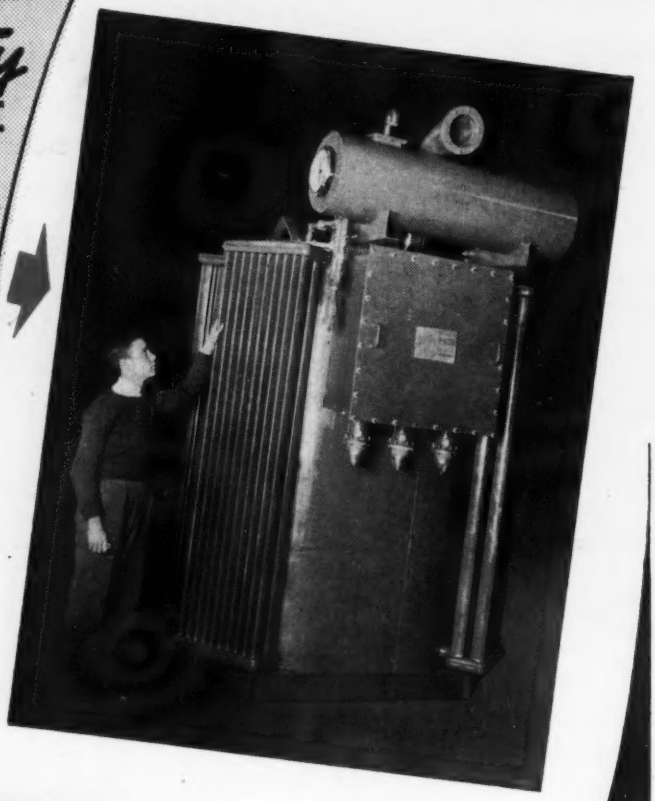
BETHLEHEM·PENNSYLVANIA

In Canada: Roller-Smith Marsland, Ltd., Kitchener, Ontario

STANDARD AND PRECISION ELECTRICAL INSTRUMENTS • AIRCRAFT INSTRUMENTS • SWITCHGEAR
AIR AND OIL CIRCUIT BREAKERS • ROTARY SWITCHES • RELAYS • PRECISION BALANCES

UPTEGRAFF POWER Transformers

FOR Utility SERVICE



Uptegraff Power Transformer, Type O.I.S.C. single phase, 60 cycle, 11,500 volt primary to 460 volt secondary, with primary junction box and cover-mounted secondary.

To fulfill your needs for custom-designed and built Power Transformers, the Uptegraff organization offers completely adaptable engineering and plant facilities.

In addition to special features incorporated in your specifications, all Uptegraff Transformers are designed and built in strict accordance with applicable standards of AIEE, NEMA, EEI and ASA specifications.

Our engineering and manufacturing experience and abilities, together with our flexible plant facilities, enable us to readily and completely satisfy your Power Transformer needs.

Tell us your requirements.

R. E. UPTEGRAFF Manufacturing Co.
SCOTTDALE · PENN'A · U.S.A.

lets and drops from the line. Meter boxes contain resistance to simulate meter coils and so provide test indications simulating those in the field. Switches on the back of the board connect resistance to indicate customer load and permit tests in connecting services to differentiate between meter and customer load.

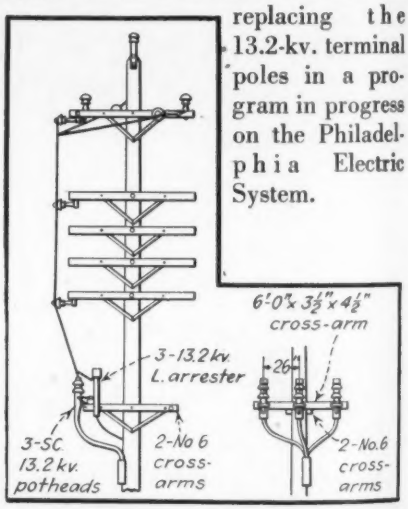
Disks in one of the primary circuits allow demonstration procedure in inserting or removing a single phase boost or buck transformer.

The model is also used to demonstrate to estimators and dispatchers the work that crews must do in performing certain work. Although they train in the field with crews, it is difficult for these men to follow all testing operations from the ground. A combination of field and model training gives them a better understanding of the work.

•

Pothead on Crossarm Provides More Clearance

Two important factors were instrumental in changing the arrangement of risers at the same time as replacing the 13.2-kv. terminal poles in a program in progress on the Philadelphia Electric System.



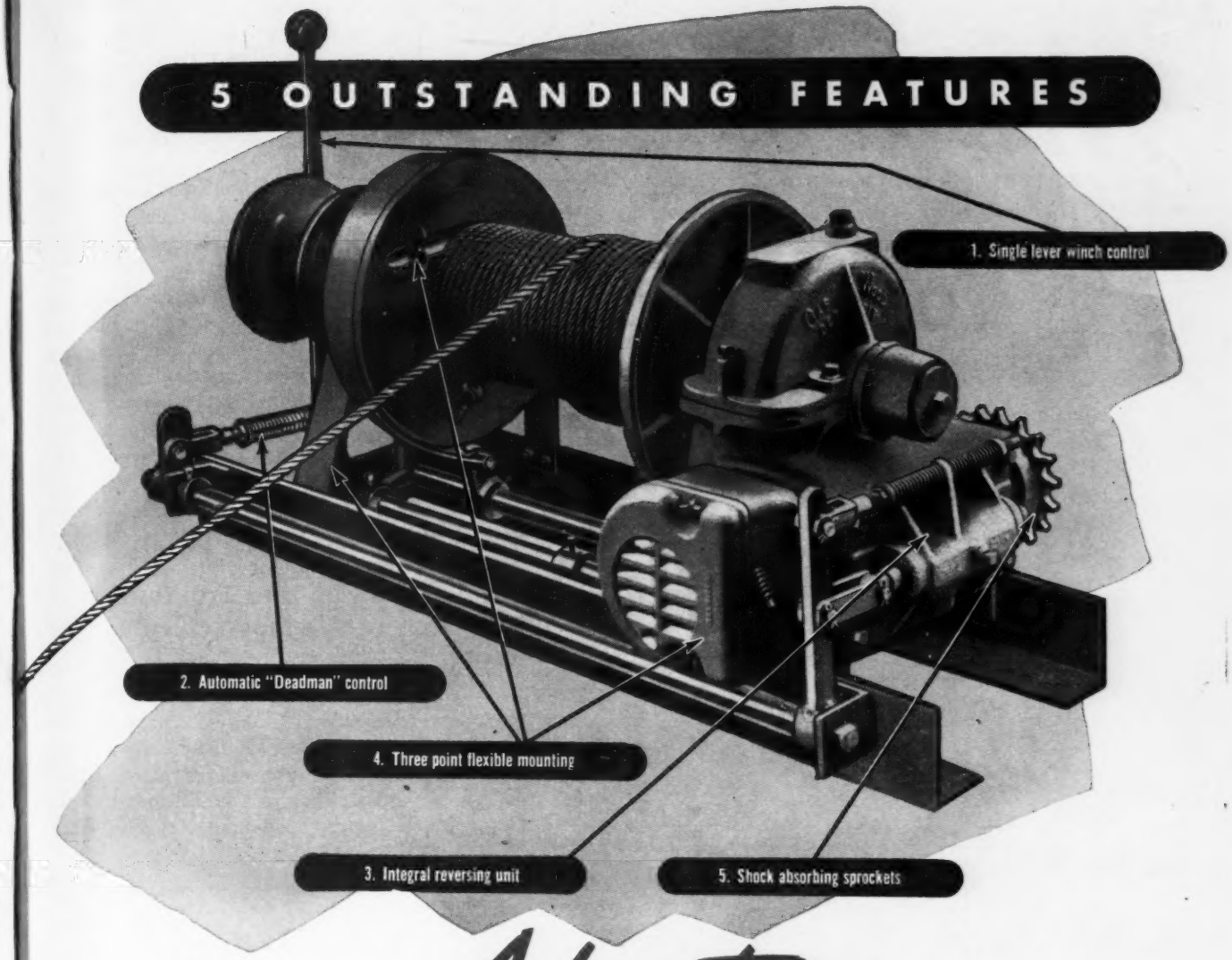
DETAILS of pothead support on 13.2-kv. riser pole. Two No. 6 buck arms support the 6-ft. by 3½-in. by 4½-in. crossarm to which the potheads and arresters are bolted, back-to-back

These factors were:

1. Doubling the distance between the potheads and the pole and thereby providing greater climbing clearance.

2. The risks of occasioning a short circuit or a ground were decreased by using a wooden crossarm in place of a metal bracket.

Details of the newer type of construction, suggested by Adolph Runge,


5 OUTSTANDING FEATURES
1. Single lever winch control
2. Automatic "Deadman" control
4. Three point flexible mounting
3. Integral reversing unit
5. Shock absorbing sprockets

Advantages

of Gar Wood winches which have been proved on every fighting front – wherever the "heavy lifting squads" had work to do.

★ With the control lever mounted in the open—the operator has a clear view of the work—not seated in the cab and dependent on relayed signals

★ The new and exclusive Gar Wood integral reverse gear mechanism provides complete winch action. Once in power gear, the operator can raise or lower or hold loads without declutching or shifting the power take-off gears. Forward, reverse action or holding is done under full load.

★ The 3-point flexible mounting, another exclusive Gar Wood feature, permits flexing of the chassis without cramping the drum or distorting the shaft. The entire unit is self aligning, thus giving a right angle pull to the cable. Special heat-treated mounting bolts are used.

★ The automatic "deadman" control is another exclusive Gar Wood feature. When the operator takes his hand from the control lever it returns to neutral and the powerful automatic brake holds the load.

★ Gar Wood traditional excellence in design and manufacture are evidenced in this super winch. For instance: The oversize shaft of special steel is carried by spherical bearings—the input and output shafts are mounted in self-contained, oversize ball bearings which are constantly lubricated—the winch sprockets are rubber mounted to absorb shock—and the winch units are interchangeable which permits any required mounting.

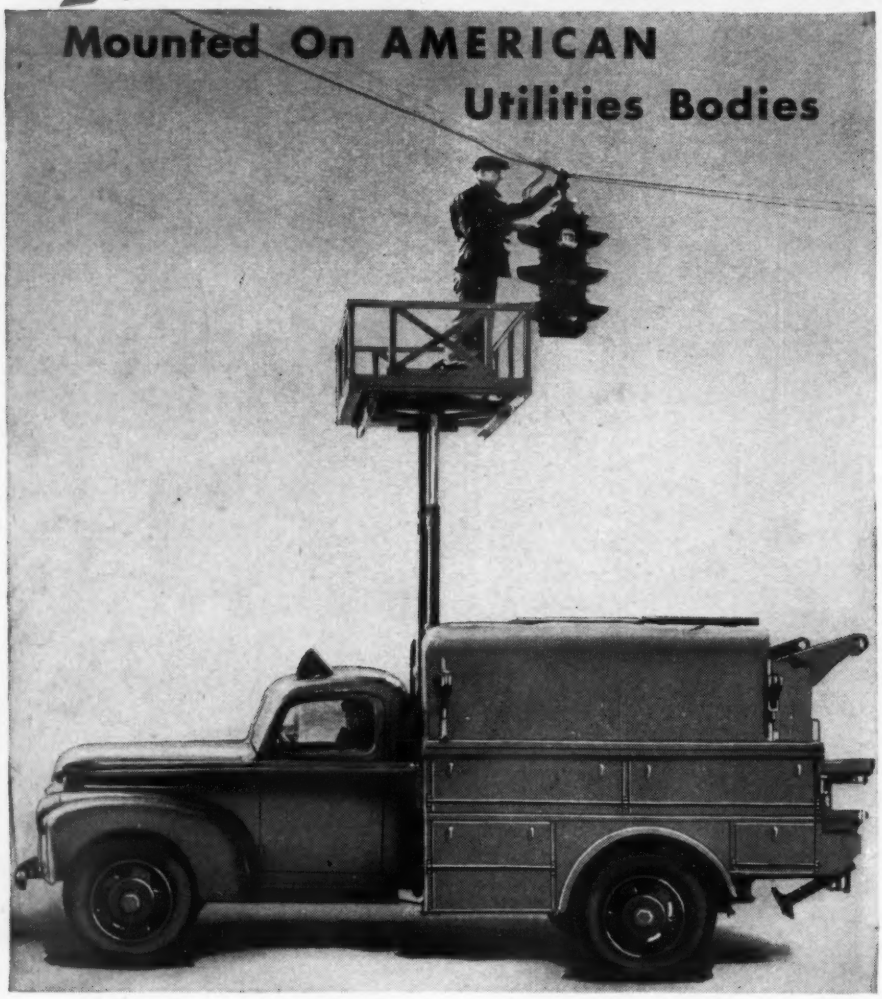
★ Every Gar Wood winch is tested at the factory under full rated load to assure perfect operation.

(Patent Applied For)

GAR WOOD INDUSTRIES, INC.

DETROIT 11, MICH. WORLD'S LARGEST MANUFACTURERS OF TRUCK AND TRAILER EQUIPMENT

American BIRD-WHITE TOWER LIFTS



. . . A Time and Money Saving Combination for Maintenance and Service of Highway, Street and Signal Lights . . . .

Here's a simple easy, efficient and economical method for service and maintenance of your signal, street and highway lights, for trimming trees and for much of your heavy line work on the highways. It is a real time saver and assures safety and comfort to your crew.

The American Bird-White combination equipment offers; — low initial heights, in some instances almost flush fittings — extreme elevations, up to 28 feet — sturdy construction, without excess bulk — rigid stability — elimination of sidesway at all tower elevations — assured with specially designed hydraulic jacks. Trouble-free high pressure rotary pump actuated by a power take-off permits smooth operation in the raising and lowering of the tower controlled from the lift platform.

For complete details and specifications write today —

THE American COACH & BODY CO.
PUBLIC UTILITIES EQUIPMENT FOR MOTOR VEHICLES

a line foreman, are shown in the accompanying illustration. The potheads are bolted to a 6-ft. by 3½-in. by 4½-in. crossarm which, in turn, is bolted to the extreme ends of two No. 6 buck-arms.

This results in a 3-ft. clearance between the pole and pothead, which is double that previously afforded with the metal bracket.

Individual conductor risers are supported by "aeroplane type" brackets mounted at the tips of the arms supporting the local distribution circuits. The three lightning arresters are supported by the same crossarm and are placed back-to-back with the potheads.

•

Derrick and Tarpaulin Move Surplus Dirt

Line crews of Wisconsin Electric Power Co., Milwaukee, use their pole derricks to good advantage in disposing of surplus dirt from pole holes and other excavations in residential areas. They just shovel the dirt onto a large, rope-bound tarpaulin, hook

ROPE-BOUND tarpaulin being used to remove surplus dirt from pole excavation site as in a residential area

the four corners onto the winch line hook, pick it up with the winch lines as shown and move off. Until someone struck on this idea surplus dirt was shoveled on the back of the truck and carted away to a dump or other point and shoveled off again.

"ILLUMINATION

. . . FUNDAMENTALS AND APPLICATION"

Westinghouse supplies the timely answer in this course especially tailored for power companies:

- **18 Soundslide Films**
- **10 Sets of 6 different Lesson Books (actually 18 lesson books bound into 6 volumes)**
- **An Instruction Manual**
- **A Lighting Handbook**

Every day counts in the big race for that reconversion and remodeling dollar! For further details, get in touch with your Westinghouse representative now. Or write for additional information to *Lamp Division*, WESTINGHOUSE ELECTRIC CORPORATION, Bloomfield, New Jersey

ALL IN ONE

COMPLETE PACKAGE!

Easily taught—easily understood through the unique Soundslide Films and the same basic method of simplified visual training proved by the Armed Services to be the best way to teach technical subjects quickly . . . thoroughly. And what a thorough training this course gives!

Copyright 1945, Westinghouse Electric Corporation

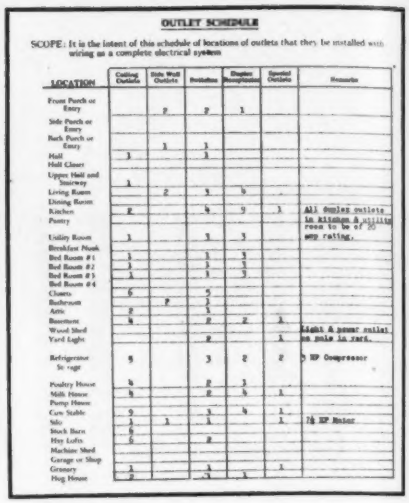
LOAD BUILDING

Commercial · Industrial · Residential · Rural

Aiding Adequate Farm Wiring

Adequate wiring for the farmstead is regarded as so essential to satisfactory service that the Western Massachusetts Electric Co., Greenfield, is planning to increase its advisory work in this direction and ultimately to provide the farmer with complete analyses and suggestions on the prewar liberal scale. In a paper on rural electrification before the New England Council's farm electric service committee, F. Leslie Foss, assistant to the president, Western Massachusetts Co., points out that unless some such assistance is given, the average farmer is not sufficiently well acquainted with wiring to get the best results from the money expended, particularly when it comes to the capacity of his entrance equipment. Along with this, many farmers like to receive the utility's advice as to the particular type of equipment which they should purchase. At this time the company feels that in the near future many so-called "gyp" appliances will be on the market, and wishes to do everything in its power to prevent such material getting into the hands of its customers.

The prospective farm customer receives a bound folder (9 in. by 11⅜ in.) describing the company's farmstead wiring plan, with specific recommendations for an adequate wiring installation, prior to its construction. This folder amounts to a manual supplementing the company's rules and regulations applying to meter and service connections, and seeks to provide for extension of service and proper sized wires to outbuildings, and the installation of switches of ample capacity for these. Central service distribution is advised with separate feeders to each building, thus enabling future loads to be handled with a minimum disturbance to existing wiring. Points are given on dry locations for wiring, the field for using corrosion-resistant materials, mechanical protection of wiring and safeguarding wiring devices and lamps in locations subject to dust (as hay-mows), clearances from livestock damage, floodlighting yards, outlets and their locations, motor protection and ratings, fuses and circuit breakers, fire protection and the use of proper methods in additional wiring. Fifty-six favored uses of elec-



OUTLET SCHEDULE

SCOPE: It is the intent of this schedule of locations of outlets that they be installed with wiring as a complete electrical system

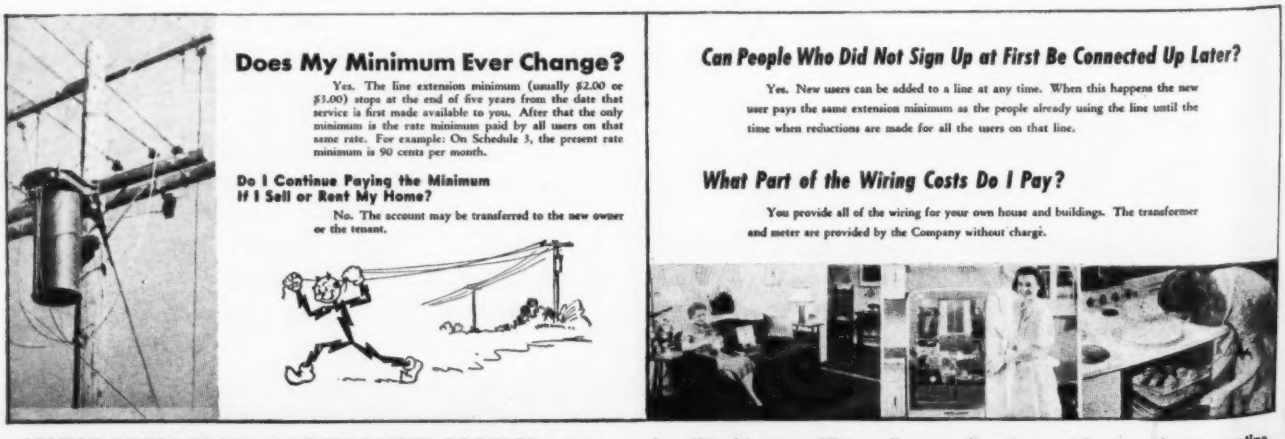
LOCATION	Ceiling Outlets	Side Wall Outlets	Switches	Duplex Receptacles	Special Outlets	Remarks
Front Porch or Entry		2	2	1		
Side Porch or Entry						
Back Porch or Entry		1	1			
Hall	1		1			
Hall Closet						
Upper Hall and Stairway	1					
Living Room		2	1	1		
Dining Room						
Kitchen	2		4	3	1	All duplex outlets in kitchen & utility room to be of 20 amp rating.
Pantry						
Utility Room	1		1	1		
Breakfast Nook						
Bed Room #1	1		1	1		
Bed Room #2	1		1	1		
Bed Room #3	1		1	1		
Bed Room #4						
Closets	5		5			
Bathroom		1	1			
Attic	2		1			
Basement	4		2	2	1	
Wood Shed					1	Light & power outlet on pole in yard.
Yard Light			2		1	
Refrigerator Sewage	1		1	2	2	½ HP Compressor
Poultry House	4		2	1		
Milk House	1		2	1	1	
Pump House						
Cow Stable	3		1	1	1	
Silo	1	1	1		1	1½ HP Motor
Stock Barn	6					
Hay Lofts	1		2			
Machine Shed						
Garage or Shop					1	
Granary	1		1			
Hog House	2		1	1		

OUTLET SCHEDULE proposed for a farmstead, includes lighting outlets, convenience and heavy duty receptacles

• • •

Booklet Answers Rural Extension Questions

So many questions regarding rural service were asked by prospective farm customers of Washington Water Power Co. that the company has issued a 16-page booklet setting forth line extension policy and rules and answering the many questions that naturally arise in the minds of customers-to-be. Besides detailed information on extension policy the rural rate is shown in simple chart form, information is given on house and farm building wiring and how to read the meter and concludes with "first easy steps toward all-electric living."



Does My Minimum Ever Change?

Yes. The line extension minimum (usually $2.00 or $3.00) stops at the end of five years from the date that service is first made available to you. After that the only minimum is the rate minimum paid by all users on that same rate. For example: On Schedule 3, the present rate minimum is 90 cents per month.

Do I Continue Paying the Minimum If I Sell or Rent My Home?

No. The account may be transferred to the new owner or the tenant.

Can People Who Did Not Sign Up at First Be Connected Up Later?

Yes. New users can be added to a line at any time. When this happens the new user pays the same extension minimum as the people already using the line until the time when reductions are made for all the users on that line.

What Part of the Wiring Costs Do I Pay?

You provide all of the wiring for your own house and buildings. The transformer and meter are provided by the Company without charge.

SAMPLE PAGES FROM AN ATTRACTIVE BOOKLET gotten up by Washington Water Power Co. for guidance of prospective rural customers. Sixteen-page publication gives company's line extension policy in addition to answers to questions

LET PHILCO HELP YOU MODERNIZE WITH MODERN FLOTÉ STORAGE BATTERIES

Yes, it's urgent that you get your expansion plans under way with all possible speed. And Philco is ready to help you with the famous Floté Storage Batteries that have *proved* their lower operating cost for many utility companies. This modern control battery is the only battery with special engineering, special construction and special high-efficiency grid material for today's full float service. There is a Philco Floté Battery for every control and auxiliary power need . . . in glass, rubber or vitrabloc jars. Write today for latest catalogs.

PHILCO CORPORATION
Storage Battery Division, Trenton 7, N. J.
Makers of the famous Philco "Thirty"

PHILCO

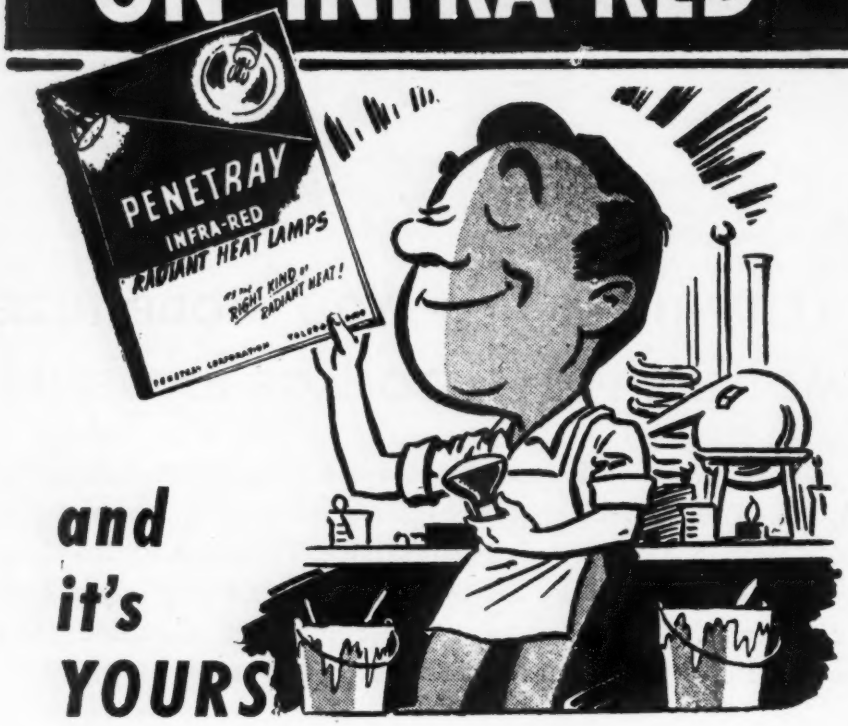
Famous for Quality the World Over

Tune in The Radio Hall of Fame, Paul Whiteman and His Orchestra, Sundays, 6 P.M., EST.

FOR 50 YEARS A LEADER IN INDUSTRIAL STORAGE BATTERY DEVELOPMENT

Philco Floté Storage Battery in encased Sonal Glass Jar.

AN INSTRUCTIVE BROCHURE ON INFRA-RED



and it's YOURS

A Post Card Will Bring It

•

IT TELLS THE COMPLETE STORY AND SHOWS BEAUTIFUL INSTALLATIONS OF INFRA-RED

•

PENETRAY

TRADE MARK

WILL SEND IT TO YOU—FREE

PENETRAY CORPORATION
TOLEDO 5, OHIO

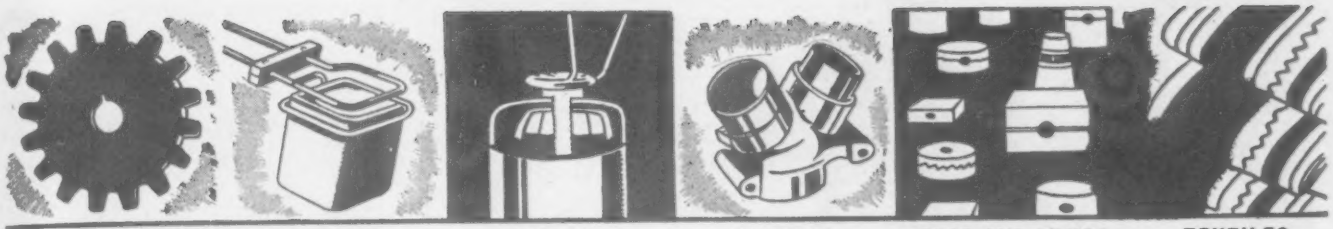
tricity for progressive farming and modern home making are listed. Blueprints (8½ in. by 11 in.) are attached, giving for the particular prospect the recommended sizes of wire to serve the various buildings and the proposed location of outlets and switches within the home, with plans to scale. A table giving general guidance to the number of lighting outlets, convenience receptacles and heavy duty receptacles desirable for the farmstead is also included, and finally, the individual customer is given a recommended outlet schedule for his particular premises.

Following the establishment of the company's recently approved five-year contract for rural service extensions, a large volume of inquiries has been received from prospective farm customers. The basis (domestic rate applies) is a $2 per month guarantee per farm customer for any line extension one-third of a mile or less long to serve a single customer, or any line extension, of whatever length, having farm customers at the rate of three or more per mile of extension. For any extension above one-third of a mile to serve a single farm customer, or for any extension, however long, having less than three farm customers per mile, the company charges 35 cents more per month per farm customer for each 100 ft. or fraction by which the extension exceeds one-third of a mile.

•

Lighting Design For A Model School Room

To establish a room that would represent the best in modern classroom facilities, one that could be used as an experimental room to guide modernization in other parts of the system, the Evanston (Ill.) School Board selected the sixth grade room at Noyes School, oldest building in the school system. This room, which is 34 by 26 ft., faces south and has four large windows in its east wall, one in the north. There are blackboards on the front and right walls. Prior to modernization natural illumination was supplemented by two 200-watt incandescent lamps in glass bell shades suspended from the 12-ft. ceiling. Both the floor and surface of the old-style desks were dark. Desks formerly were in straight rows facing the front of the room. Shades at



HARDENING STEEL | SOLDERING | BRAZING | PLASTICS | FOOD AND DRUGS | TEXTILES

heat

induction or dielectric

WHEN you need it
WHERE you need it
FAST with MEGATHERM*

Ready . . . at the push of a button . . . MEGATHERM's megacycle energy puts heat *where* you want it . . . instantly!

Induction . . . for thin-skin and contour hardening, annealing, brazing and soldering. Ferrous and non-ferrous metals quickly processed!

Dielectric . . . for uniformly heating plastic materials, rubber, food, drugs, wood, textiles and cosmetics . . . rapid defrosting of frozen food!

There's a MEGATHERM to fit your need . . . and a MEGATHERM Electronic Application Engineer to show you how MEGATHERM electronic heat can help you do a better job . . . build a better product.

Write on your company letterhead *today* for details.

FEDERAL TELEPHONE & RADIO — FTR

Federal Telephone and Radio Corpor

AN IT&T ASSOCIATE

Newark 1, N. J.

*REG. U. S. PAT. OFF.

O.Z. POWER CONNECTORS

For superior mechanical strength, for ease of assembly, for maximum electrical conductivity, specify *O. Z.* Power Connectors with confidence:

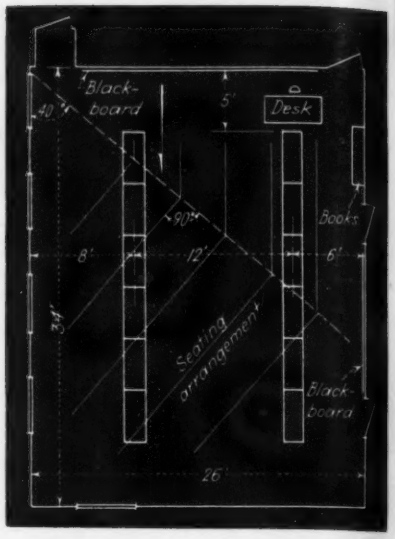
An inter-dependent bolting system makes O. Z. Connectors *stronger.* Their Hex Cup construction speeds assembly — only one wrench is needed for tightening.

And long, dependable service is assured by the corrosive-resistant copper alloy used in their construction.

See for yourself the details that make O. Z. Power Connectors superior—on every important count. Write for the large, illustrated O. Z. catalog today.

O. Z.
ELECTRICAL PRODUCTS
- Solderless Connectors
- Cast Iron Boxes
- Conduit Fittings
- Cable Terminators
- Grounding Devices
- Power Connectors

O.Z. ELECTRICAL MFG. CO.
262 BOND STREET · BROOKLYN, 2 N. Y.
REPRESENTATIVES IN PRINCIPAL CITIES



LIGHTING LAYOUT for model grade school classroom. Note asymmetrical spacing of fluorescent fixtures to take advantage of natural light; also diagonal arrangement of seats to minimize the effect of sky glare

the tall windows pulled down from the top and so were inadequate for proper control of natural light.

Directly or indirectly all of these conditions which needed attention, lighting, decoration, desk and desk arrangement, floor color and window shades, were concerned with lighting and the improvement of seeing conditions in the room. A large part of the transformation of the room into a model classroom, therefore, was a job for an illuminating engineer. Accordingly, lighting engineers of the Public Service Co. of Northern Illinois were called in. Design of the model room is the result of their efforts.

Uniform illumination on working surfaces of 45 foot-candles was established as a lighting objective. To achieve this, modified industrial-type louvered fluorescent fixtures were installed in two continuous rows of six fixtures, each equipped with three 40-watt 3,500-deg. white lamps. Fixture rows were run parallel to the axis of the room and spaced to take advantage of natural light from the windows. The first row is 8 ft. from the windows; the second 6 ft. from the wall. Space between rows is 12 ft. Fixtures were suspended two feet from the 12-ft. ceiling. Initial desk-top intensity was 65 foot-candles; maintained level is expected to be 45 foot-candles on the desk tops.

Room decoration was coordinated with the lighting. Ceiling and wall surfaces out of the line of sight were

HURRICANE!

Motorola F-M 2-WAY RADIOTELEPHONE

helps Florida power company repair storm's damage—*FAST!*

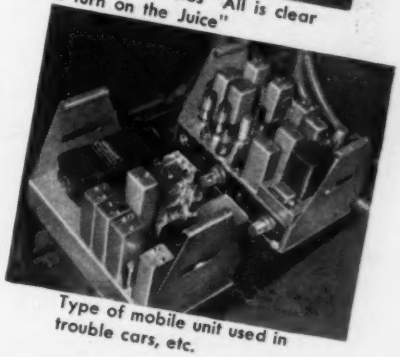
Screaming wind, driving rain, battering breakers and engulfing tides—these are the terrible instruments of the hurricane that periodically cuts its path of destruction along our Atlantic seaboard.

This year, however, the power company was better equipped than ever before to combat the ravages of the storm. Motorola-equipped patrol cars followed in the wake of the gale, reporting line breaks to Motorola-equipped repair crews and to the power station. The company reports that radiotelephone was especially valuable in expediting repair work, because crews could order current turned off and on at will.

Motorola can expedite *your* line-maintenance job, too.

Emergencies emphasize the value of radiotelephone, but you'll find that it is in everyday routine operations that Motorola pays its biggest dividends. Write today—Motorola engineers will be glad to show you how radiotelephone can increase the efficiency of your particular operation—there's no obligation, of course.

Trouble man radios "All is clear and turn on the Juice"



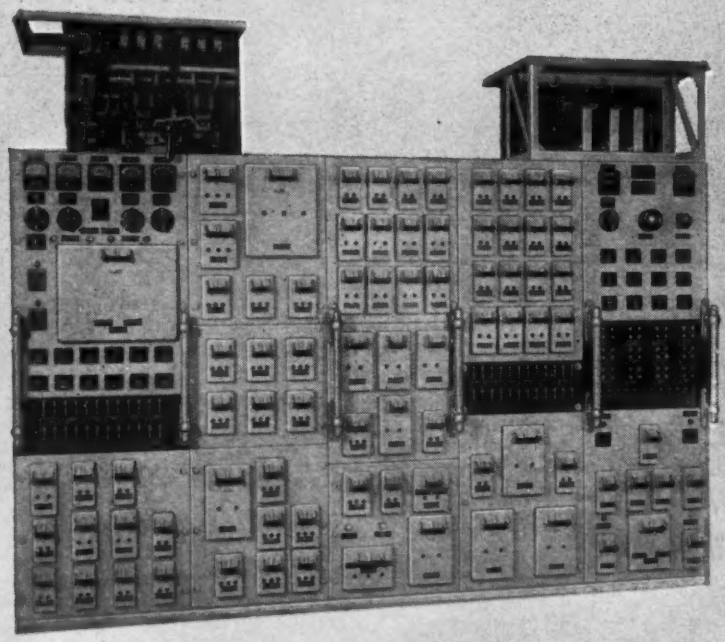
Type of mobile unit used in trouble cars, etc.

GALVIN MFG. CORPORATION • CHICAGO 51

COMMUNICATIONS AND ELECTRONICS DIVISION

F-M & A-M HOME RADIO • AUTO RADIO • AUTOMATIC PHONOGRAPHS • TELEVISION • "HANDIE TALKIES" • POLICE RADIO • RADAR

No Matter HOW DIFFICULT YOUR PROBLEMS MAY BE—



Main IC Switchboard for Heavy Cruisers, designed by Pelham Engineering Department for the U. S. Navy

—our switchboard designers have probably solved them

IN designing the Main IC Switchboard for heavy cruisers, shown above, our engineers were given the problem of meeting all of the U. S. Navy's exacting requirements within rigid space limitations. The design proved to be completely satisfactory . . . The wide experience of Pelham engineers, in designing every type of switchboard and special panelboard, can be helpful to you . . . Highest standards of quality, and dependable deliveries . . . Your inquiries are invited.

PELHAM ELECTRIC MANUFACTURING CORP., Erie, Penna.

SPECIALIZED DESIGN **Pelham** UNEXCELLED QUALITY

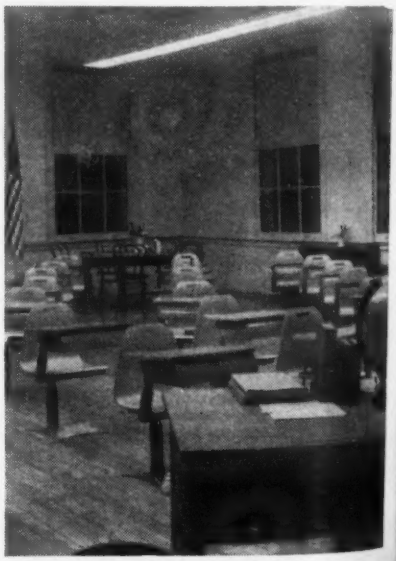
• SWITCH BOARDS • PANEL BOARDS • SWITCH GEAR AND ACCESSORIES

given a flat white finish to provide maximum glareless light reflection. Walls in the fixed line of sight have been given a dusty-pink tint to provide a restful eye view and an approach to the color temperature of natural light.

Adjustable posture desks of a modern design were installed and given a dull natural wood finish to minimize reflected glare. To minimize the brightness contrast between desk top and background the floors were bleached and sanded to a light finish that matches the desk tops.

The orientation of seats was also made to conform to modern sight saving practice. Seats were arranged diagonally away from the windows so that children can obtain the greatest amount of natural light without being exposed to sky glare. When seats face front it has been found that children tend to duck and set up body stresses in attempting to shield their eyes against sky glare from windows. Seats at Noyes School back of a line running 40 degrees from the plane of the windows were set perpendicular to that 40-deg. line. All other seats face front as shown.

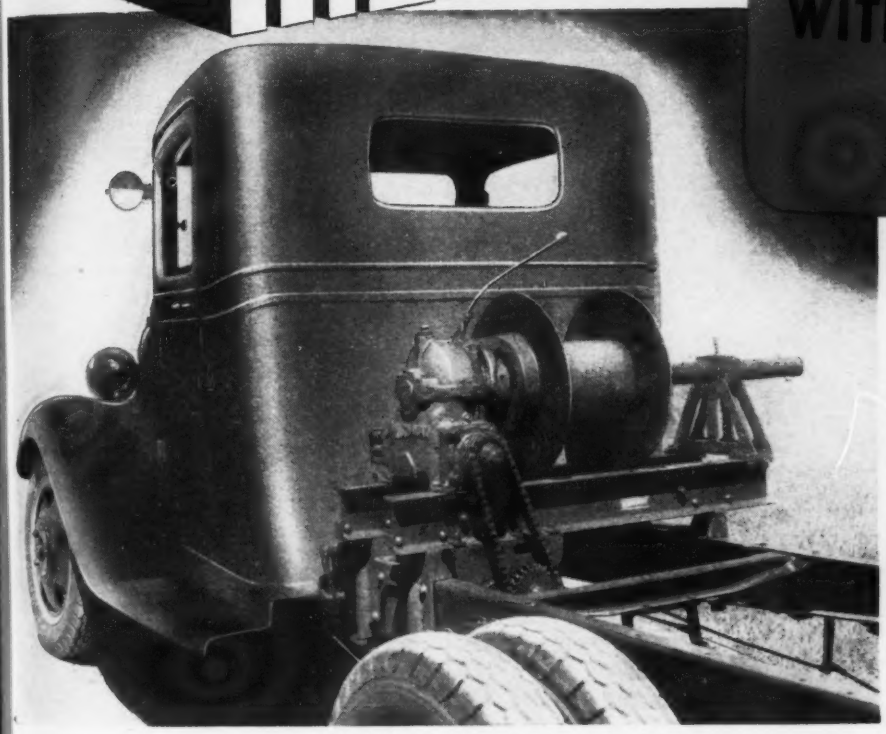
As a further protection against sky glare and to provide greater flexibility for the control of natural light, center-mounted window shades are to be installed which can be drawn over the top or bottom of the window.



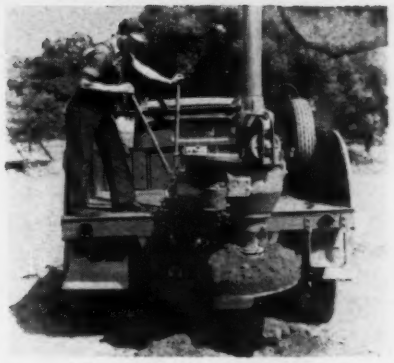
UNIFORM ILLUMINATION of 45 foot-candles, maintained, was lighting design objective. Dull natural wood finish on desk tops matches floor color; walls have dusty pink tint in line of sight, ceiling and upper wall area in flat white. Two continuous rows of louvered-bottom fixtures are suspended two feet from 12-ft. ceiling

HIGHWAY

TOP PERFORMANCE WITH MAXIMUM *Safety*



Model L-12-C Winch

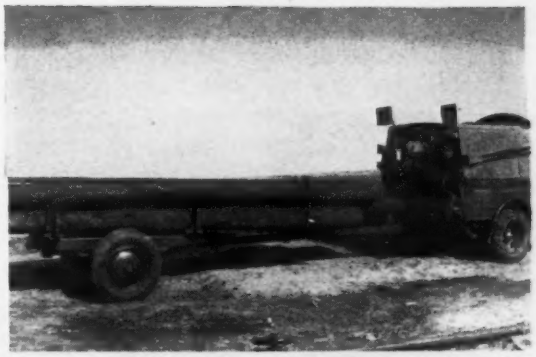


Model HD Boring Machine

Model LCW-102 Body

Highway winches are built to do their job easily, safely and efficiently. The single drum winch shown is made of electric cast steel and is used with middle type pole derricks. It is a small, free drum type, with ample strength for heavy-duty truck operation, yet its light weight permits use with 1½ and 2 ton chassis. Far from ordinary . . . it is tops in winches of this type.

Highway also offers efficient Propeller Shaft Power takeoffs as well as the easily installed "Transmission Type". Highway winches and power takeoffs are specifically designed for public utility work.



MODEL P-8-T POLE TRAILER

HIGHWAY TRAILER COMPANY

MANUFACTURERS OF

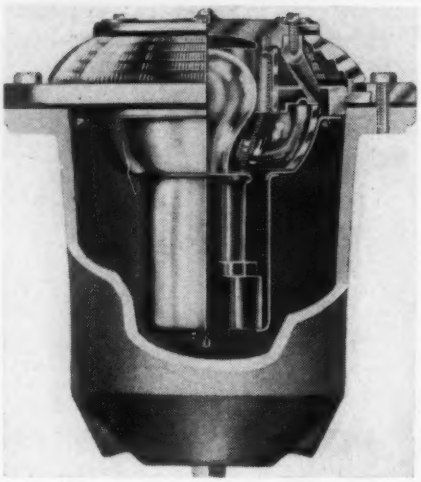
TRUCK TRAILERS AND BODIES • EARTH BORING MACHINES • WINCHES • OTHER PUBLIC UTILITY EQUIPMENT

General Offices

EDGERTON, WIS., U. S. A.

NEW EQUIPMENT

Contact Light

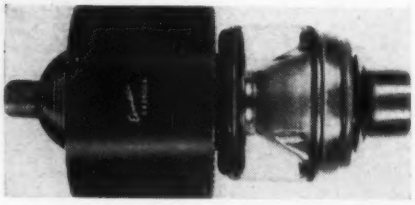


Contact light for airport runways: carry dead load of 50 tons. **Westinghouse Electric Corp.**, Box 868, Pittsburgh, Pa.

Light is a foot in diameter and projects 2¾ in. above the ground and is interchangeable with A-N standard contact lighting dimensions. The frame is of cantilever type and is made of the new high strength alloy steels developed during the war. The frame carries the load; the lens floats on synthetic rubber gaskets. The lens is reported to have high light transmission values, and is heat treated to withstand impacts, but in case of breakage flies in small pieces which have no sharp edges to cut tires.

•

Tube



Type "3T2500A3" medium mu, forced-air cooled, external anode transmitting tube. **Eitel-Cullough, Inc.**, San Bruno, Calif.

Tube is reported as suitable for use at frequencies in the V.H.F. range, as well as in the lower frequencies. The grid terminates in a ring interposed between the plate and filament, to permit maximum convenience in the use of the tube as a "grounded-grid" amplifier at high frequencies with coaxial plate and filament tank circuits. It is also provided with a low-inductance cylindrical filament-stem structure, which allows a smooth transition between a linear filament tank circuit and the tube. One tube is reported as capable of delivering an r.f. output of 5,000 watts at 3,500 plate volts at low frequencies, and 3,500 watts at 3,000 plate volts at a frequency of 110 Mc.

•

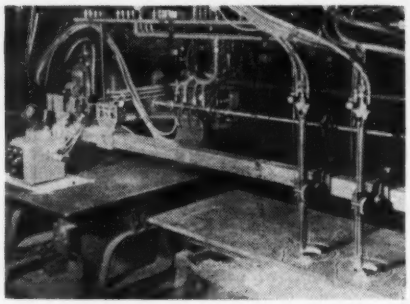
Wire

Delabeston appliance lead wire; max. operating temp. 125 deg. C. **General Electric Co.**, 1285 Boston Ave., Bridgeport 2, Conn.

Wire is insulated with a moisture-resisting cellulose acetate wrap next to the conductor, a layer of felted asbestos and a lacquered glass braid over-all covering. It is available in white, red, green, blue, brown and black.

•

Electronic Control



Electric eye tracing device. **Air Reduction Sales Co.**, 60 E. 42nd St., New York 17, N. Y.

Device consists of a tracing head and a control box and is used with pantograph oxyacetylene cutting machines. It is stated that the cutting of intricate pieces is obtained by following the outline drawing or silhouette, and that metal or wood templates are unnecessary.

•

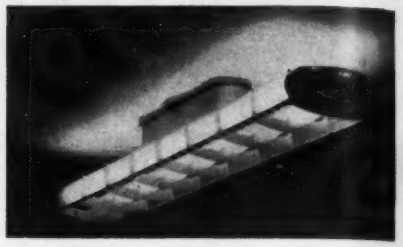
Soldering Flux

No. 30 soft solder liquid flux. **Superior Flux Co.**, Public Square Building, Cleveland 13, Ohio.

Material is an organic soft soldering flux which may be used on copper, steel, silver, brass, various alloys and electroplated parts such as nickel plate, silver plate and cadmium plate. The report states that, if after solder the work piece is washed with water, corrosion forming residues are removed.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Fluorescent Unit

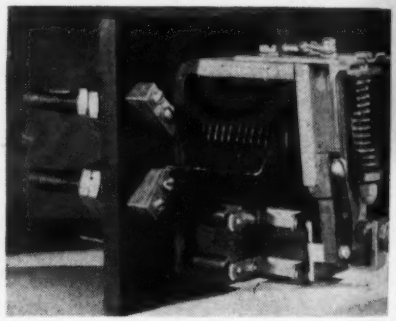


Domestic fluorescent fixture: two sizes, two-lamp 20-watt and two-lamp 40-watt. **John C. Virden Co.**, Cleveland, Ohio.

The units have luminous side panels, curved louvers to add free flowing lines, and metal end plates with insets of molded translucent plastic. Canopies are rigid to hold luminaires in fixed position. The louvers are hinged and starters inset to facilitate servicing.

•

Relay



Type AYJ overload and jamming relay: capacities, from 75 to 625 amp.; insulated for 600 volts. **Westinghouse Electric Corp.**, P. O. Box 868, Pittsburgh 30, Pa.

Relay for d.c. operation is said to provide almost instantaneous overload protection on general purpose and mill motor applications and to prevent damage to hoist, windlass and capstan equipment when load or cable jams. The single-break, normally closed contacts and the double-break auxiliary contacts are reported as suitable for carrying 5 amperes continuously and for interrupting a d.c. inductive coil load of 150-amp. maximum. The relays are operated by a series or copper strap wound type of coil. The armature and frame surfaces are reported as protected with a hard chromium plate.

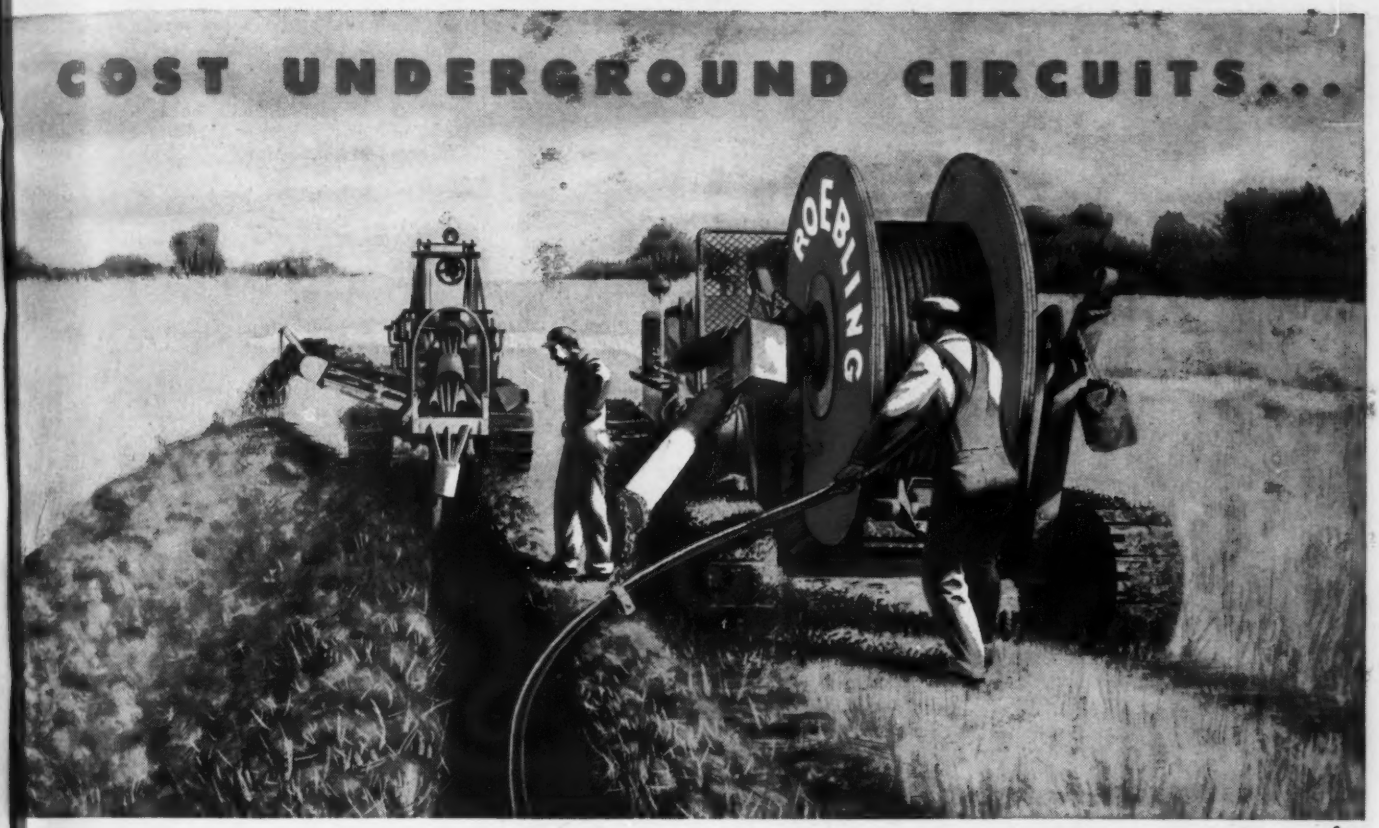
•

Communication Equipment

Hand-held microphone and retrap cord. **Avometer Corp.**, 370 W. 35th St., New York, N. Y.

A hand-held carbon microphone which is usable on radio and interphone systems and is reported to give 7 milliwatt output for

COST UNDERGROUND CIRCUITS...



Its non-metallic construction offers you many desirable advantages. Less expensive than metallic armored for one. And freedom from sheath losses, electrolysis, stray current heating, chemical disintegration, and arcing grounds. Added outstanding advantages of the neoprene sheath are its oil, ozone and sunlight resistance.

Roebling manufactures other high quality parkway cables too, metallic and non-metallic, in many types and sizes. All conform to I.P.C.E.A. specifications. A Roebling engineer is ready to help you make the best and most profitable selection for *your* service conditions. Write for complete details.

JOHN A. ROEBLING'S SONS COMPANY
Branches and Warehouses in Principal Cities
TRENTON 2, NEW JERSEY

Pacemaker in Wire Products

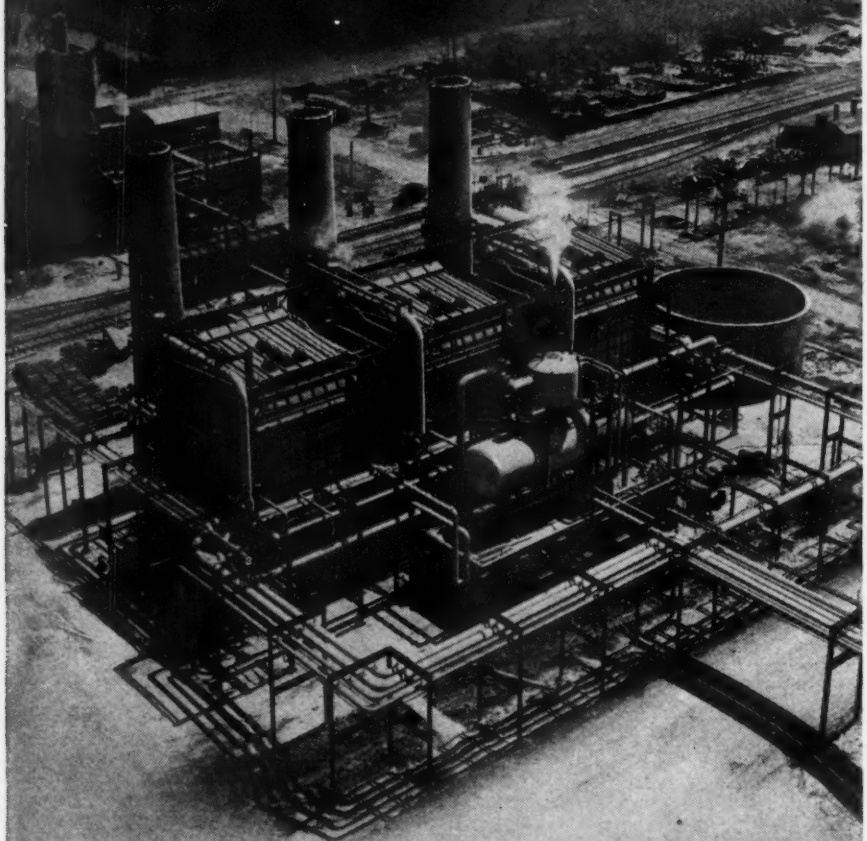
WEATHERPROOF WIRE • SERVICE ENTRANCE CABLES RUBBER-COVERED WIRES AND CABLES (INCLUDING THIN-WALLED INSULATED BUILDING WIRES AND CABLES) RUBBER SHEATHED PORTABLE CABLES • MAGNET WIRE TELEPHONE WIRES • PIGTAIL AND BRAIDED COPPER TROLLEY CONTACT WIRE • RUBBER INSULATED POWER CABLES • VARNISHED CAMBRIC POWER CABLES • BARE COPPER STRAND

L I N G

JR ROEBLING

AND CABLES

To see
EXTRA VALUES
. . . inspect a few
"POWER PLANTS
by PRITCHARD"



Benefit from our broad experience in the design, engineering and construction of UTILITY and INDUSTRIAL POWER PLANTS, either complete new stations or additions and alterations. Also, any part of our thorough service is available separately.

J.F. Pritchard & Co.

ENGINEERS • CONSTRUCTORS • MANUFACTURERS

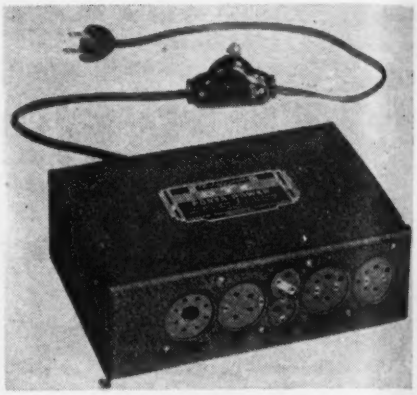
POWER DIVISION • FIDELITY BLDG. • KANSAS CITY, MO.

HOUSTON, TULSA, PITTSBURGH, CHICAGO, NEW YORK, DETROIT, ATLANTA, DENVER, SALT LAKE CITY, EL PASO, OMAHA, LOS ANGELES, MEXICO CITY and WILLITS, CALIF.

an input of 100 dynes per square centimeter (normal close-speaking voice). An acoustic low frequency cutoff and response to 5,000 cycles is said to provide good performance under difficult noise conditions. The unit is reported as spray proof and reinforced at connection.

•

Power Supply



Model "H" Porta-Power unit: for 4, 5 or 6 tube 1½-volt battery farm or portable radios; operates on 105 to 125-volt, 50 or 60 cycle lines. **General Transformer Corp.**, 1250 West Van Buren St., Chicago 7, Ill.

Unit has a two section filter, composed of three condensers and two iron-core chokes in the "A" supply and two condensers and an oversized choke in the "B" supply to block out hum. It has universal sockets for battery plugs and is said to be adaptable to 99 percent of all portables. Circuit is reported to compensate for changes in line voltage.

•

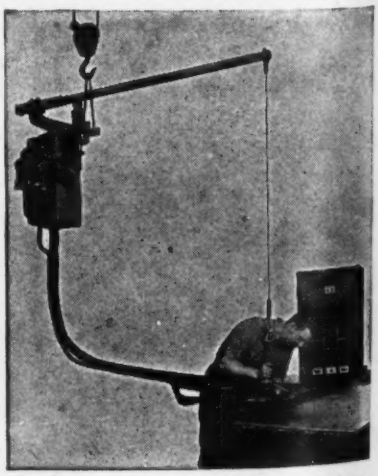
Resistor

Akra-Ohm type 188 wire-wound resistor: max. resistance one megohm; rated at one watt; 1 13/16 in. long x 3/8 in. diam. **Shallcross Mfg. Co.**, Jackson & Pussey Ave., Collingdale, Pa.

Fixed wire-wound resistor has 3-in. axial leads of No. 20 tinned copper wire. Standard tolerance is plus or minus one percent, although higher accuracy up to 0.1 percent is available.

•

Spot Welding Units



Overhead type spot welding units: transformer ratings of 50, 75, and 100 kva. are available. **Sciaky Bros.**, 4915 W. 67th St., Chicago, Ill.

Units are available with either pneumatic or hydraulic systems and a variety of gun

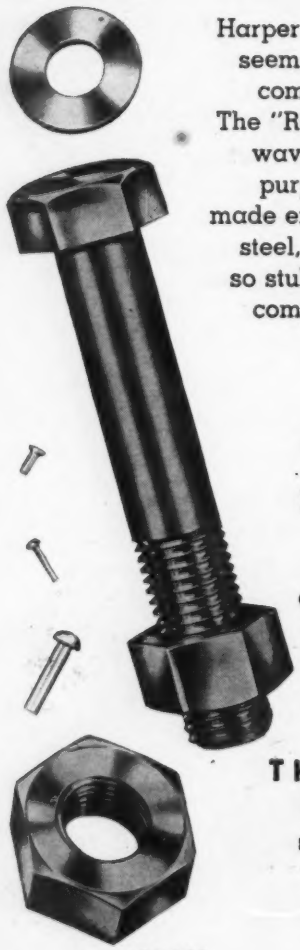
"reconvert Qikly"

with Burndy QIKLINE CONNECTORS

Install quickly with an ordinary wrench —cast of high strength, high copper alloy—high compression contact assured by oversize studs—each size takes broad range of cable sizes—Send for CATALOG # 41. Burndy Engineering Co., Inc., 107J Bruckner Blvd., New York 54, N. Y.

in spite of the elements

Harper Everlasting Fastenings, at first glance, may seem remote from the Rock of Gibraltar, but the comparison is closer than you might suppose. The "Rock" has withstood the elements of wind and wave and time for centuries. To all intents and purposes it is Everlasting. Harper fastenings, made exclusively from non-ferrous metals or stainless steel, also resist the elements, rust and corrosion so stubbornly that they are considered Everlasting compared with common steel—or the products in which they are used.



everlasting fastenings

Harper Everlasting Fastenings may be ordered from a stock of over 5000 items including bolts, nuts, screws, washers, rivets, nails and special fastenings. Other special fastenings are made to order quickly from large stocks of raw material. Write for 104 page catalog.

THE H. M. HARPER COMPANY
2611 Fletcher Street . Chicago 18, Illinois

BRANCH OFFICES: New York City • Philadelphia • Los Angeles
Milwaukee • Cincinnati • Houston
Representatives in Principal Cities

BRASS
BRONZES
COPPER
MONEL
STAINLESS

HARPER
Chicago

styles in both alligator and "C" types. Spring type or pneumatic balances are provided for ease of positioning the gun. Transformers may be with or without top switch. Electronic units are available for control of welding sequence, current interruption and control of welding heat. Unit may be permanently suspended for use on production lines, or hung from any jib hoist, monorail, etc., for tack or structural welding on large assemblies.

TECHNICAL LITERATURE

Switch Operating Mechanisms—Bulletin No. 4508 describes and diagrammatically shows nine arrangements of switch operating mechanisms. A table is included with phase spacings for potentials from 7.5 to 161 kv. Copies may be obtained from Delta-Star Electric Co., 2400 Fulton St., Chicago 12, Ill.

Clutch—A method of reducing starting currents, increasing power factor, lowering connected load, provide overload protection and use a smaller motor is described in bulletin No. 108. Copies may be secured from Mercury Clutch Corp., 19 Rector St., New York, N. Y.

Speech—"Elements of Speech Input Systems" is a booklet which describes, in non-technical language, the principal components and performance data of a typical modern speech input system for both AM and FM broadcasting. Copies are available from Western Electric Co., 195 Broadway, New York 7, N. Y.

Manual — "Ready Reference Electrical Insulating Materials Manual" is a 20-page bulletin on the theory and behavior of dielectrics. Among the materials described are varnished cambric, cotton, gases and liquids, glass synthetics, mica, oils, paper, quartz and varnishes. It contains tables and curves which classify the materials and list the properties. Copies may be obtained from William Brand & Co., 276 Fourth Ave., New York 10, N. Y.

Metals — Booklet entitled "Hydbride Process" describes and gives some of the properties of metallic hydbrides, titanium, zirconium, titanium-copper alloys, zirconium-copper alloys, special metals and powdered alloys. Copies are available from Metal Hydbrides, Inc., Beverly, Mass.

Meters—Bulletin No. 1770 describes frequency meters, their operation, reeds, effects of temperature, adjustment of amplitude and devotes one section to scale reading. Copies may be obtained from James G. Biddle Co., 1211 Arch St., Philadelphia 7, Pa.

Welding—"Building Your Career in Arc Welding" is a bulletin describing Lincoln's course in welding and subject matter covered. Copies are available from Lincoln Electric Co., 12,818 Coit Rd., Cleveland 1, Ohio.

Cellulose Acetate—Booklet describes the manufacture, properties and uses of cellulose acetate. Among the tables included are the properties, solvents useful with the acetate, compatability of resins with it, starting formulas for specialty lacquers, and properties of cellulose acetate plastics and laminates. Copies may be obtained from Hercules Powder Co., Wilmington 99, Del.

Measurements — Bulletin E-54(2) describes the procedure and technique used in measuring dielectric constant and power factor of a dielectric in solid or liquid forms, and also explains the arrangement of the circuit. Copies are available by writing Leeds & Northup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

NEWS ABOUT PEOPLE

Mauney Heads Rural Unit for Arkansas Power Co.

Ross Mauney, formerly farm management specialist for the Arkansas Extension Service, has been employed as director of the new rural development department of the Arkansas Power & Light Co., a feature of the company's "Make Our Company The Best" program.

R. Mauney

A native of Arkansas and a graduate honor student of the University of Arkansas College of Agriculture, Mr. Mauney worked for five years throughout Arkansas as an appraiser for the Federal Land Bank in St. Louis before joining the Extension Service. He has served as county agent in three counties in addition to his work as state farm management specialist.

"Mr. Mauney will work with all agencies interested in increasing the farm income in Arkansas," Executive Vice-President C. S. Lynch of A. P. & L. said in announcing Mr. Mauney's employment.

•

▶LEE C. PRICKETT has been appointed agricultural engineer in charge of the Bonneville Power Administration's rural utilization program. Mr. Prickett goes to the Bonneville staff from the War Department in Washington, D. C., where he helped to engineer supply requirements for the African invasion and prepared military intelligence reports on the electrical facilities available in Palestine, Iran, Indo-China, Borneo and the Philippines. Prior to his work with the War Department, Mr. Prickett served seven years as assistant director of the national Committee on the Relation of Electricity to Agriculture and also spent seven years with the Tennessee Valley Authority and the Rural Electrification Administration.

•

United Engineers Elect Three Vice-Presidents

United Engineers & Constructors, Inc., Philadelphia, has announced the election of Charles W. E. Clarke, Benjamin S. Thayer and Stanley C. Cook as vice-presidents.

Mr. Clarke, who has been elected vice-president and consulting engineer, has specialized in the field of steam engineering practice for the last 35 years, serving as consulting engineer with United Engineers since its organization in 1928 and in a similar capacity with Dwight P. Robinson & Co. of New York between 1919 and 1928. Among his earlier associations were Stone & Webster Engineering Corp., and Sargent & Lundy. Mr. Clarke has been a frequent contributor to technical society and engineering publications. He is a fellow of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers of Great Britain.

Mr. Cook, who was made vice-president and construction manager, has been prominent in the construction industry for the past 30 years, having had charge of the construction of many large industrial and institutional developments with particular emphasis in the Philadelphia District. Prior to the merger of Day & Zimmermann Engineering & Construction Co. in 1928, as one of the constituent companies forming United Engineers & Constructors, Inc., Mr. Cook was construction manager in charge of important work for that organization.

Mr. Thayer, who has also been made vice-president and construction manager, has served as a construction manager with the organization since 1928. During this period he has been in responsible charge of a large volume of steam power plant and industrial work in this country and subways and other important work in Buenos Aires. Prior to the merger of Dwight P. Robinson & Co. of New York with United Engineers, Mr. Thayer was a construction manager with the former organization and with the Aluminum Co. of America on industrial developments and dams in the United States and Brazil.

•

Weston Appoints Olesen General Sales Manager

Announcement has been made of the appointment of Harold L. Olesen as general sales manager of the Weston Electrical Instrument Corp., Newark, N. J. H. L. Gerstenberger, who formerly served in that capacity, continues as vice-president in charge of sales.

Mr. Olesen has been associated with Weston since 1931 and has successively been in charge of radio sales, assistant general sales manager and sales promotion manager. His prior experience includes connections with the Signal Corps, World War I; American Marconi, now RCA; Fansteel Products Co.

H. L. Olesen

and Jewell Electrical Instrument Co. During the war his activities at Weston included that of war activities co-ordinator; consultant to the War Production Board; chairman, NEMA priorities and materials allocation committee, and member of the Weston post-war committee. Mr. Olesen is a member of the American Institute of Electrical Engineers.

In connection with the elevation of Mr. Olesen, an improved home office sales structure has been developed. Under this new plan, the sales department is divided into two groups: a product division, manned by product experts, to

Royal-ettes

#26 in a series of informative news letters from a producer of Power Switching Equipment

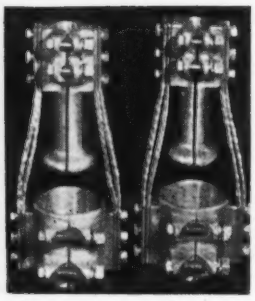
OUR FIRST YEAR IN PRINT . . . .

This advertisement marks the first year in which this company has discussed its products and policies continuously in *Electrical World*. Royal emerges from the war years stronger and more determined than ever before to serve the utilities and industrials well.

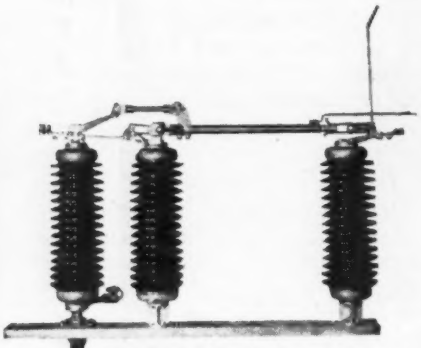
Engineering service—not bigness—is our aim, for as we have said before, we would rather operate conservatively and with special helpfulness to our customers than to assume the complexities and inertia or undue bigness.

We aspire to be regarded as a manufacturing organization of imagination, ready any time to try out a new idea. We have made a number of worthwhile contributions ourselves to the art of power distribution, we believe, but more importantly have instilled in our sales and engineering departments an eagerness to accept the suggestions of our customers. We are sure this policy is making for real progress.

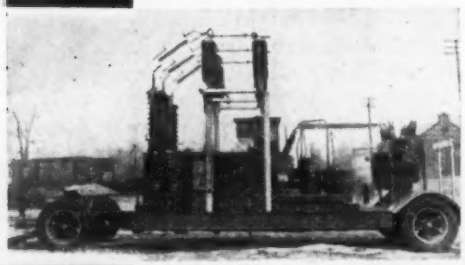
Most of the products shown on this page were developed in direct cooperation with utility engineers faced with a particular need. When you have a tough problem yourself, something that calls for special engineering design, remember that we'd like to tackle it with you.



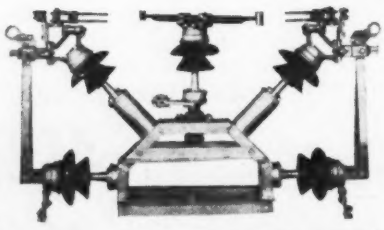
Bus Fittings—a full line



Gang-operated switch, type VVL



One of the first portable substations



By-Pass Switch

ROYAL ELECTRIC MFG. CO. 619 E. 40th Street CHICAGO 15, ILL.

handle details associated with sales, and a marketing division, staffed by a group of experienced market men, to develop and maintain the markets in which Weston products are sold.

•

General Electric Elects Two Vice-Presidents

George R. Prout, general manager of the General Electric Co.'s air conditioning department, and L. R. Boulware,

G. R. Prout

responsible for the operations of G. E. affiliates and consultant on marketing and merchandising, have been elected vice-presidents of the company.

With the establishment of the air conditioning department as one of the

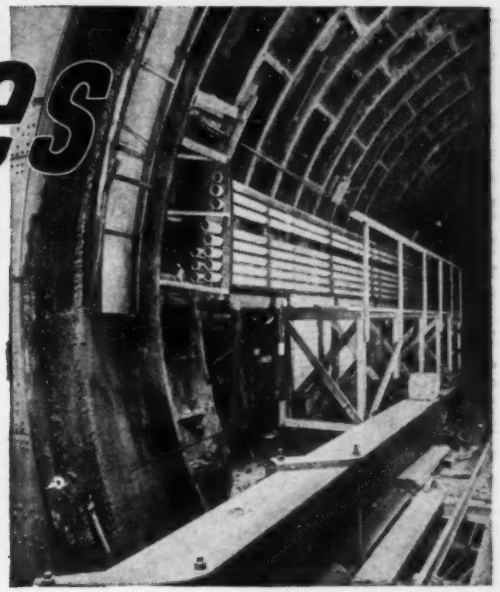
L. R. Boulware

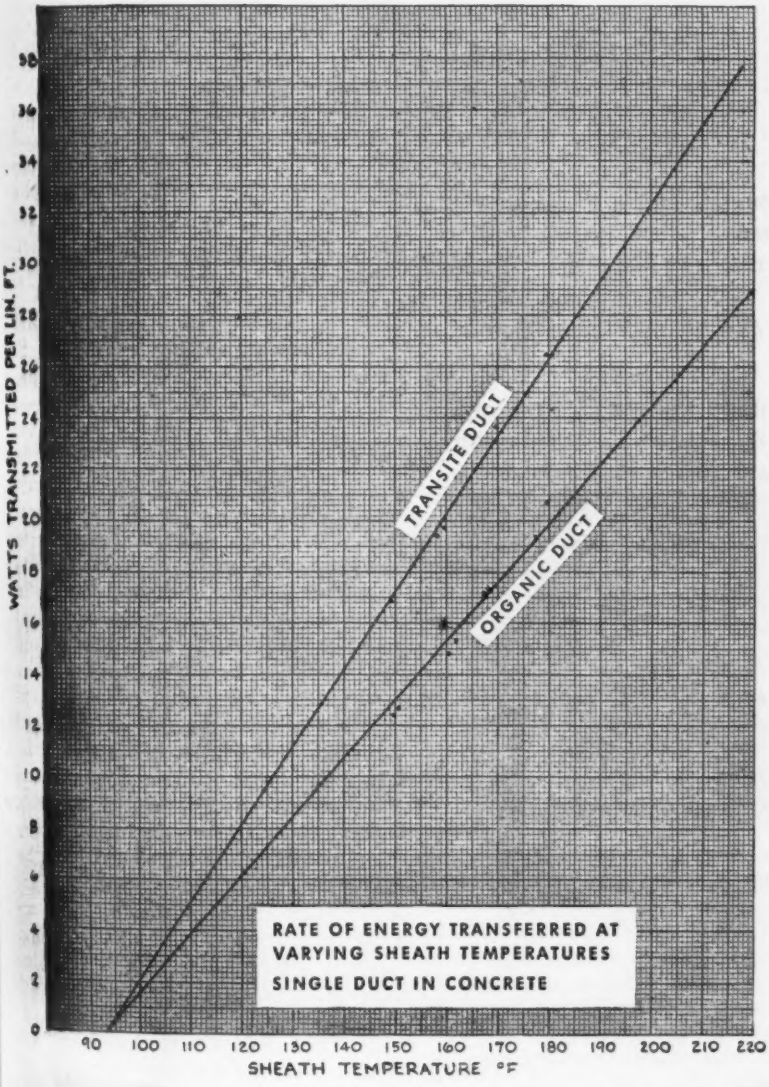
six G. E. operating departments last April, Mr. Prout was named general manager with headquarters in Bloomfield, N. J. He has been connected with the company since 1920.

Mr. Boulware joined General Electric last January, having been operations vice-chairman of the War Production Board, which had been headed by Charles E. Wilson, president of General Electric. Previous to his service with WPB, Mr. Boulware had been vice-

Cooler Cables

proved in the laboratory and in operation with Transite Ducts





AS THE GRAPH shows, Transite Ducts made of asbestos and cement have a much higher rate of heat transfer than organic conduit. Tests in the Johns-Manville Laboratories, later applied to specific field conditions, proved that Transite Ducts dissipate I_2R losses 13% faster than other ductways tested, thus keeping cables cooler.

In actual operation, this means that cables installed in Transite Ducts have a higher inherent load capacity, or, carrying rated loads, will run cooler, thereby reducing copper losses and increasing cable insulation life.

Transite Ducts, made of asbestos and cement, are strong, immune to rust and rot. They are incombustible and unaffected by electrolysis or galvanic action. A permanently smooth bore makes possible long cable pulls and easy replacements. Long, lightweight lengths can be quickly and economically installed. In addition, a variety of fittings simplifies even the most complicated installations.

For full information write for Data Book DS-410: Johns-Manville, 22 East 40th Street, New York 16, N. Y.

The chart shows why Transite Ducts keep cables cooler than ordinary organic ducts.

Johns-Manville

TRANSITE DUCTS

CONDUIT for use without concrete

KORDUCT for concreting in

JOHNS-MANVILLE JM PRODUCTS

DEAD ACCURATE
EASY TO USE

Takes out guesswork of "sight and sag", or oscillation wire stringing. Hooked on in a jiffy. Indicates tension in seconds. Measures only 8¼" x 6¼" x 3". Capacities 500 to 20,000 lbs.

A Lot of Critical Testing to Do

MAKE SURE WITH THE
DILLON
DYNAMOMETER

The Dillon is universally used in telephone work. Accuracy, and long-lived dependability are the answers. Indicates exact tension in guy strand, messenger and wire.

Many other uses where pull, torque, weight or overload are vital factors.

Write, wire or phone for illustrated Dynamometer Manual.

W. C. Dillon & Co., Inc.
5423 W. HARRISON ST., CHICAGO 44, ILL.

SPEER'S

Dependable Data

Makes PERFECT MATCH of brush and machine

Here's an easy way to get the longest, most trouble-free brush service in your commutating motors and generators: give the problem to SPEER. Take advantage of the extensive service data SPEER has accumulated through almost 50 years' specialization in *matching brushes — mechanically and electrically — to individual machines.*

SPEER knows, from long experience, the brush grade best suited for any set of operating characteristics and service conditions. Its all-inclusive line of standard and special carbon, graphite, electro-graphite, and metal-graphite brushes, includes grades that will deliver peak performance in your equipment — with fewest brush renewals, less maintenance.

So for brushes *perfectly matched* to your machines—call on SPEER. Write for Brush Data Forms.

CHICAGO • CLEVELAND • DETROIT
MILWAUKEE • NEW YORK • PITTSBURGH

SPEER
CARBON COMPANY
ST. MARYS, PA.

270

president and general manager of both the Carrier Corp. and the Celotex Corp. He had also been general sales manager of the Easy Washing Machine Corp.

•

▶ GEORGE WALRATH has been named manager of the Head of the Lakes Electric Cooperative at Superior, Wis., to succeed LUDWIG ANDERSON, who has received a new assignment.

▶ PAUL BROWN, who has been eastern division sales supervisor of the Alabama Power Co., has been made merchandise sales director in the office of J. S. Sutherland, manager of the residential and commercial division.

▶ D. B. HYER, JR., has been appointed manager of the industrial development department recently organized by the Florida Power Corp. Mr. Hyer, who has been with the utility system for almost twenty years, has been assistant superintendent of transmission and distribution for the past three years and has served in sales and engineering positions in all parts of the system since joining the company shortly after graduation from the Georgia School of Technology.

▶ BEN W. CREIM has been appointed regional power manager of the U. S. Bureau of Reclamation, Sacramento, Calif. Mr. Creim has spent the past three and one-half years in the Navy, which recalled him from the Bonneville Power Administration, where he had been in charge of all BPA's electrical construction work since 1939. Prior to his employment with BPA, Mr. Creim spent three years with the REA in charge of design and construction of more than 70 REA projects in the eleven western states. In his new position, he is responsible for formulating and executing plans for the full development of the power resources under the jurisdiction of the Bureau of Reclamation within Region II. From 1927 to 1936, he was chief electrical engineer for the Modesto Irrigation District, where he was in charge of management, design, construction and operation of the electrical properties of the district. Mr. Creim is a fellow of the American Institute of Electrical Engineers.

▶ K. WILDE BLACKBURN has been appointed associate solicitor in charge of legal work for the Rural Electrification Administration, to succeed the late Vincent D. Nicholson. Mr. Blackburn, who was engaged in legal work for REA from 1935 to 1943, is thoroughly familiar with the legal problems of REA. Since 1943 he has been assigned to other legal work for the Office of the Solicitor in Washington, including that of the Commodity Credit Corporation and

Philadelphia Evening Bulletin Photo

Men and women stop to marvel at a helicopter. There is something miraculous about a machine that hangs or moves in the sky without wings or propeller. And flies forward, sideways or backward—hovers in one spot—rises or descends vertically, linking air travel with the ground, to make flying an easy step to anywhere.

The helicopter's high crowd appeal was shown (above) a few months ago in a demonstration of the Kellett XR-8 military model at Fairmount Park, Philadelphia, under sponsorship of the U. S. Army Air Forces.

With the ease of a hummingbird, the XR-8 flew in, high over the crowd, and settled to rest in a space only 100 feet square. Then the helicopter soared straight up, backed, swung from side to side like a pendulum, whirled, hovered. Finally it sped forward, at a faster clip than a motor car let loose on an express highway, in complete mastery of speed, height and direction.

Just what the public's keen interest in helicopters will mean in future industrial and commercial uses for this unique type of machine is more than we at Kellett Aircraft can forecast. As the oldest American designers and producers of rotary-winged craft, we consider one of the helicopter's most valuable features something we did *not* design or make—its inherent "crowd appeal," even to a nation which accepts modern streamlined trains and 400 mile-an-hour airplanes without a second glance.

Operating details, including cost and payload, may postpone the widest practical application of the helicopter. However, specialized money-making applications seem close at hand. Kellett Aircraft and other important organizations in the helicopter field are devoting time, money and experience to hasten the day when these craft will meet the expectations of their most loyal boosters — the American public. Kellett Aircraft Corporation, Upper Darby, Pa.

KELLETT HELICOPTERS

TAKE YOUR HANDS OUT OF OLD-STYLE STRAIT-JACKET *GLOVES*

Surety GIVES YOU "FINGER *FREEDOM*"

In both curved and straight-finger types, Surety Turn-Cuff Linemen's Gloves let you work limber. Pick up tools, handle wires and cables with full flexibility even when you wear leather protectors. Surety Turn-Cuff is the patented "petticoat-insulator" design that minimizes surface creepage in adverse weather, gives two added inches of protection when cuffs are worn turned down in normal conditions.

Linemen everywhere favor Surety Turn-Cuffs for comfort and assured safety. Turn-Cuffs are individually tested to guarantee that they exceed safety standards. Specify Turn-Cuffs!

THE *Surety* RUBBER CO.
CARROLLTON, OHIO

the Farm Security Administration. His new appointment relieves him of his position as associate solicitor in charge of Farm Security Administration legal work.

•

Crosley Corp. Elects Mahan Vice-President

Announcement has been made by The Crosley Corp., Cincinnati, of the selection of S. D. Mahan as vice-president

S. D. Mahan

and general sales manager of the manufacturing division. Under Mr. Mahan's direction will come all commercial activities, including export and domestic sales, advertising and service.

Mr. Mahan joined Crosley in 1943 after spending two and one half years with the U. S. Treasury Department as director of advertising and promotion for the War Bond program and as associate national field director in charge of all War Bond and Stamp sales. He has continued his association with the war finance division of the Treasury Department in the capacity of consultant.

Mr. Mahan has spent more than eight years in the electrical appliance field, first as merchandise advertising and promotion manager and later as general advertising manager of the Westinghouse Electric Corp.

•

▶ LOUIS T. BARRY has been appointed manager of the power and industrial division of the Electric Service Manufacturing Co., Philadelphia. Prior to service in the Armed Forces, Mr. Barry was manager of the Pittsburgh office of the company and will now be located in Philadelphia headquarters.

▶ CHARLES G. LANPHIER, vice-president, Sangamo Electric Co., Springfield, Ill., was among the nine Springfield citizens recently presented certificates of honor for their contributions to the war effort.

Eley Assigned Technical Duties on CEMA Staff

Announcement has been made of the appointment of Fred C. Eley to the staff of the Canadian Electrical Manufacturers Association in the capacity of technical assistant.

For a number of years Mr. Eley was connected with Amalgamated Electric Corp. Limited, Toronto, where he was responsible for the engineering application of its products, in particular that of lighting equipment, distribution panelboards, switchboards and enclosed switches.

Mr. Eley is a graduate of the University of Toronto in electrical engineering and holds membership in the Illuminating Engineering Society, Engineering Institute of Canada and the Association of Professional Engineers of Ontario.

•

▶ LARRY FRIDLEY has been appointed to head a new architects' and builders' bureau formed by the Rochester Gas & Electric Corp. A graduate architect, Mr. Fridley was recently discharged from the army with the rank of captain after three and one-half years of service. Under his direction the new bureau will offer advice and assistance to the building profession in connection with the uses of gas and electricity in the new homes to be constructed, particularly in regard to modern kitchen planning, remodeling, ventilation, heating and air conditioning. The new bureau will be located in the company's East Avenue Building.

▶ C. E. PARKS, relay engineer, power department, Public Service Co. of Indiana, Indianapolis, has been elected president of the Indiana Engineering Council, which held its annual meeting this month in conjunction with the Indiana Society of Professional Engineers.

▶ JOSEPH R. DILLON has been placed in charge of the purchasing department of the Wiremold Company, Hartford, Conn., to succeed GEORGE M. ARMOR, who has retired after 25 years of service. Mr. Dillon, who recently returned from military service, was graduated from Trinity College, Hartford, in 1937, and has been a member of the Wiremold organization since 1940.

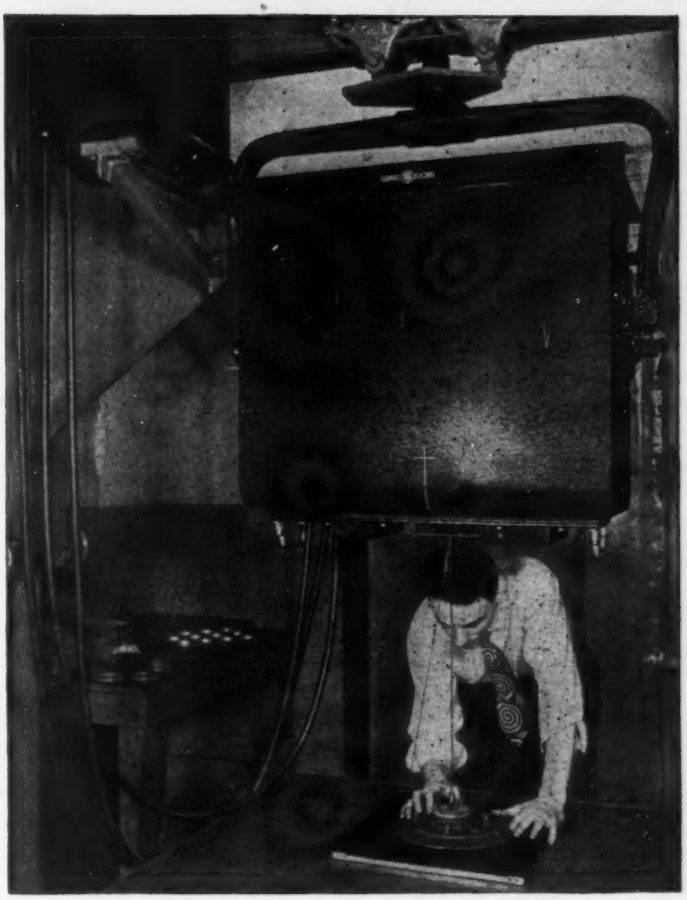
▶ T. J. MCDONOUGH, formerly connected with the Westinghouse Electric Corp., has been appointed general sales manager of the Earl B. Beach Co., Pittsburgh, Pa., which specializes in the sales of electrical insulating material, representing some manufacturers as agents and others on a jobbing basis.

MALLORY CONTACT ASSEMBLIES Must Pass X-Ray Inspections

THERE'S no guesswork about the bond between contact facings and backings manufactured by Mallory. Contact assemblies and contacts are checked with this 250,000-volt X-ray machine . . . and both the bond and structure of the metals bonded must pass a searching inspection.

Grueling life tests under the toughest operating conditions . . . precise control of every metallurgical factor . . . these are other reasons why Mallory Contacts and Contact Assemblies are noted for their dependable performance, long life and ability to withstand electrical overloads.

Mallory research has developed many new contact alloys and powdered metals. Mallory manufacturing "know-how" has produced millions of contacts and contact assemblies of uniformly high quality. Mallory design engineers have helped many industries . . . producing relays, industrial controls, circuit breakers, business machines, domestic appliances and other products . . . to specify or design the right contact or assembly *before* blueprints have left the drafting board. Thus Mallory has become Contact Headquarters.



X-ray inspection assures the quality of Mallory Contacts and Contact Assemblies made of silver, platinum, Elkonite, Elkonium* and Tungsten.*

Whether you need complete contact assemblies, individual contacts, or the assembly of contacts to your own brackets, studs, springs or arms, consult Mallory on your specific problem. Write us today if you'd like samples to test in your applications.

Write today for your copy of the Mallory contact catalog. The New Mallory Contact Data Book will be sent gratis to engineers when requested on company letterhead. Available to students, libraries and schools at $2.50 per copy, postage paid.

P. R. MALLORY & CO., Inc., Indianapolis 6, Indiana

Reg. U. S. Pat. Off. for electric contacting elements.

Photograph illustrates efficient sure grip and automatic release of Multipoint Hook.
SAVE THE POLES
• The Sturd-E exclusive Multipoint Cant Hook speeds up pole handling and saves the poles—its six quarter-inch by half-inch points grip much more firmly than a single point—in addition, they do not penetrate the creosote treatment. Result—no deep stab wounds where water collects and rot can start.
Made in three sizes for handling all poles—from the smallest to the big ones 22 inches in diameter. Every utility that has tested the Multipoint Cant Hook has reordered in ever increasing numbers—it saves poles, time, and cost.
STURD E TOOLS
a TRUE TEMPER PRODUCT
STURD E TOOLS
MULTIPOINT CANT HOOK
6 points, ¼" x ½" in size grip the pole securely but leave no deep hole to encourage rot and decay. Points renewable when worn. Furnished in small, medium and large sizes for handling poles up to 22" in diameter. Prices and complete description on request.
Distributed by
JOSLYN MFG. & SUPPLY COMPANY
Executive Offices
20 North Wacker Drive • Chicago, Illinois
Branches and Warehouses with Complete Stocks in Principal Cities of the United States

OBITUARY

▶ DR. CHARLES A. PERKINS, dean emeritus of the college of engineering, University of Tennessee, Knoxville, died on November 27 at the age of 87. In 1892 he joined the staff of the University of Tennessee, teaching at various times mathematics, physics and electrical engineering. He was professor of electrical engineering from 1906 until 1941 and dean of the college of engineering and director of the engineering experiment station from 1922 until 1941, when he retired. Since his retirement, he had served in a consulting capacity, not giving up active work until within recent months. Dr. Perkins was a fellow of the American Institute of Electrical Engineers.

▶ THORNE A. BROWNE, for some years prominently identified with the utility industry in the West, died on December 10 in Tucson, Ariz., at the age of 63. Some years ago Mr. Browne was identified with the Nebraska Railway Commission, serving as various times as chairman, member and secretary. In the late Twenties he also served as managing director and secretary for the Nebraska Section of the old National Electric Light Association. A graduate of the University of Nebraska, he was a member of the State Journal newspaper staff at Lincoln before joining the commission. Subsequently he became industrial commissioner for the Omaha Chamber of Commerce.

▶ CLARENCE H. STEWART, sales research engineer, rate and sales research department, Northern States Power Co., Minneapolis, Minn., died on October 7 after a prolonged illness. He was 67 years old. He obtained experience with the Great Northern Railway and with the City Engineers' office in St. Paul. From 1918 to 1923 he was superintendent of construction for G. J. Grant Co. of St. Paul, in charge of construction of the Hibbing Municipal Electric Plant and also at that time conducted the appraisal of the Minnesota Utilities Co.'s holdings at Eveleth, Minn. From 1924 to 1929 he was appraisal engineer for R. D. Thomas, consulting engineer of Minneapolis and special engineer for the utility commission of Hibbing. It was in 1929 that Mr. Stewart entered the employ of the Northern States Power Co. in the sales department, as research engineer.

▶ CHARLES H. VAN SLYCK, a retired electrical engineer of Westfield, N. J., died on December 7 in Memorial Hospital, New York. Born in Schenectady, N. Y., he had been a contracting engineer with the General Electric Co. Later he was vice-president and treasurer of the Watson Flagg Engineering Co., New York, retiring eight years ago. Mr. Van Slyck was a life member of the American Institute of Electrical Engineers.

▶ WALTER K. RHODES, professor emeritus of electrical engineering at Bucknell University, Lewisburg, Pa., died at his home in that city on December 12 after a long illness. He was 71 years of age. A graduate of Bucknell, he joined the faculty in 1907 as professor of electro-technics and for many years was head of the engineering department. He was made professor emeritus in 1942. Professor Rhodes was vice-president of the Lewisburg Electric Co., and the Lewisburg Union National Bank. He was a member of the American Institute of Electrical Engineers and of the Society for the Promotion of Engineering Education.

▶ ALEXANDER H. HOLCOMBE, a retired refrigerating engineer, died in Cynwyd, Pa., on December 4. He was 72 years of age. When he retired from active business two years ago, Mr. Holcombe was Philadelphia representative for the Worthington Pump & Machinery Corp. Mr. Holcombe became associated with Worthington in 1934, when it absorbed the old Carbondale Machine Co., Carbondale, Pa., with which he had been connected for ten years.

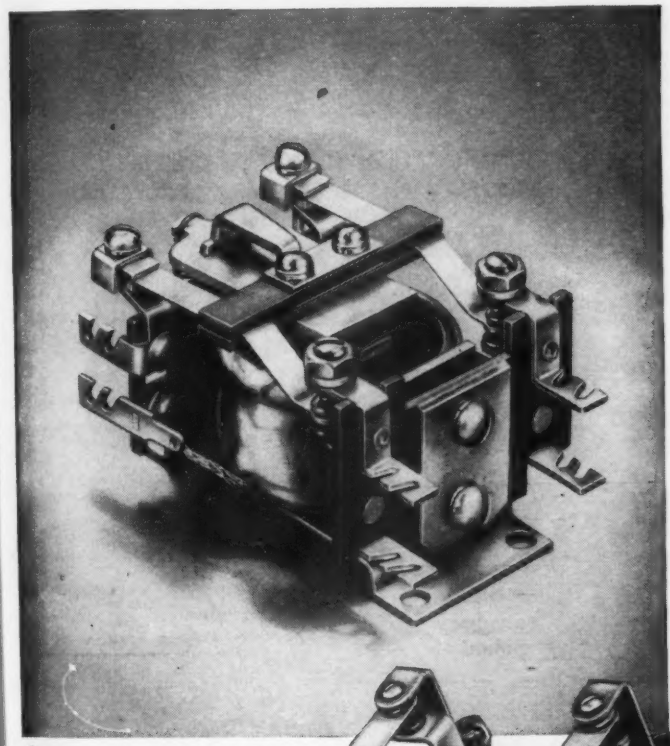
▶ JAMES A. MOYER, 70, for many years a prominent figure in engineering education in Massachusetts, retired director of the state's division of university extension, and author of numerous books on mathematics and science, died at Newton, Mass., December 1. In his early career he was associated with General Electric at Lynn, Mass., and for a time was general engineer for Westinghouse, Church, Kerr & Co., New York. He also taught at Harvard, the University of Michigan, and Pennsylvania State College.

▶ WILLIAM F. STROUSE, chief engineer of the Maryland Public Service Commission from 1919 to 1922, and a member of the commission engineering staff from that time until 1931, died at Braddock Heights, Md., on December 5. Mr. Strouse was 81 years of age.

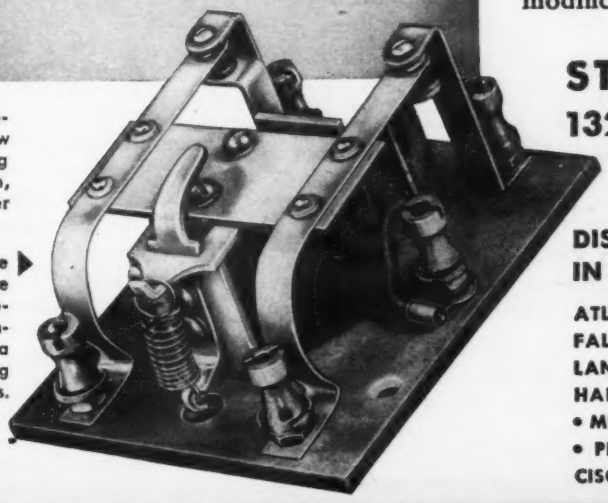
▶ AMOS L. HARD, chief electrical engineer of Thomas Emery Sons, Inc., Cincinnati, for the past 12 years, died in Christ Hospital in that city on November 26. Prior to his affiliation with the Cincinnati company, he was for 13 years employed as field engineer by Westinghouse Electric Corp. Mr. Hard was a past-president of the American Society of Heating and Ventilating Engineers.

A STANDARD RELAY FOR DOZENS OF SPECIAL APPLICATIONS

. . . requiring a compact light weight unit that handles plenty of power and is highly resistant to shock and vibration



▲ TYPE 10XBX—Two-pole, double-throw contacts, featuring phenolic insulation, metal base, and solder terminals.



Modified 10 Frame construction Type 10XBX117 for R-F application. Features include bonded mica insulation and binding post type terminals. ▶

The design flexibility of Struthers-Dunn 10 Frame a-c and d-c relays coupled with their proven dependability under adverse operating conditions make them ideal for many applications usually requiring more costly special types. 10 Frame Relays are small and light and particularly built to withstand shock and continuous vibration.

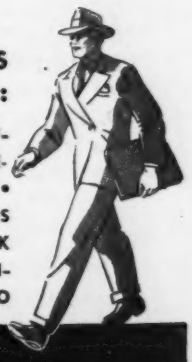
Features include: — One- to four-pole, single- and double-throw contact arrangements; insulations suitable for power or radio-frequency circuits; high contact pressures and plenty of "follow-up" for long contact life.

Struthers-Dunn #10 Frame Relays are currently used in many Radar, Radio, and Communications circuits for shipboard, aircraft and general use, including a wide variety of industrial installations requiring extra quality and plus performance. Write for Data Sheet 10-000 describing the 10-Frame Relay Series and outlining a few of the many available modifications.

STRUTHERS-DUNN, Inc.
1321 Arch Street, Phila. 7, Pa.

DISTRICT ENGINEERING OFFICES IN THESE CITIES TO SERVE YOU:

ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • HARTFORD • INDIANAPOLIS • LOS ANGELES • MINNEAPOLIS • MONTREAL • NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO



STRUTHERS-DUNN

5,312 RELAY TYPES

MANUFACTURING MARKETS

G.E. Electric Motor Division Re-Formed

Motor Division of General Electric Co's apparatus department has been reorganized, according to an announcement by K. H. Runkle, manager of industrial divisions, Schenectady, N. Y. In view of the large volume of electric motor business, and the advisability of segregating it into a natural arrangement of operating units, the motor division is now separated into four divisions and one section.

W. H. Henry, formerly manager of the motor division, has been appointed assistant manager of the industrial divisions in charge of the motor business. The following division managers have been appointed: A. W. Bartling, manager fractional horsepower motor division; Elliott Harrington, manager induction motor division; J. T. Farrell, manager d-c motor division; and P. A. McTerney, manager synchronous, large d-c, and gear-motor division.

E. A. Green, who during the war has been on war manufacturing assignments, returns to the motor organization as general assistant to Mr. Henry. D. E. Moorhead, who recently returned from the Armed Forces, is appointed assistant to Mr. Henry to give particular attention to motor sales activities. O. F. Vea continues in charge of the motor marketing and promotion section, and A. A. Merrill in charge of forecasting, order budgets and statistics group for all motor lines.

•

Storage Battery Industry Survey Will Be Made

A survey and analysis of financial and operating data for a representative sample of firms in the electric storage battery manufacturing industry is to be undertaken by the Office of Price Administration to determine whether the industry is entitled to a reconversion increase factor, and how much, if any, the factor should be.

Decision to make the survey was arrived at in the first meeting of the OPA advisory committee recently organized to represent the industry.

The advisory committee elected the following officers: Chairman, A. H. Daggett, National Battery Co., St. Paul, Minn.; Vice-Chairman, Lester Perrine, Perrine Quality Products Corp., Waltham, Mass.; and Secretary-Treasurer, Lee A. Doughty, Carlisle & Doughty, Conshohocken, Pa.

•

Plant and Offices Moved

General Luminescent Corp., Chicago, has moved into a new plant, occupying four floors in two buildings. Plants and offices are at 732 S. Federal St.

TO THE HIGHEST BIDDER—Capt. Stuart S. Murray, skipper of the battleship Missouri, indelibly autographs a new General Electric refrigerator donated by the company to the Victory Loan Drive, as Comdr. A. F. Spring, ship's executive officer, looks on. The refrigerator, bearing the names of the Missouri's officers, will be auctioned off to the purchaser of the greatest number of victory bonds. Although you can't see them here, the door of the cabinet is covered with these names, scratched into the paint from the tool in Capt. Murray's hand. Red paint will be rubbed into the scratches in order to bring out the names and the door will then be varnished to preserve for posterity the cool names of a smooth working combination

NEMA Head States Appliances Shipped

Deliveries Being Made in Spite of Reconversion Delays — Concerns Unjustly Accused of Stock Piling

R. L. White, president of the National Electrical Manufacturers Association, declared recently that shortages of materials, components, and labor in plants of electrical appliance manufacturers and in the plants of suppliers have delayed reconversion schedules somewhat, but that shipments are steadily being made to dealers throughout the nation.

"It must be borne in mind," Mr. White said, "that major appliances such as refrigerators and radios are distributed through as many as 30,000 dealers and small appliances through as many as 50,000 dealers.

"In starting from scratch, the industry faces a tremendous task just in supplying these dealers throughout the country with floor samples on an equitable basis. Some manufacturers with extensive distribution systems whose products are sold by hundreds of distributors and thousands of dealers throughout the country have felt it only fair to give all an equal opportunity to re-engage in the appliance business.

"So initial production of appliances has been withheld from distribution in some instances until sufficient were available to furnish single samples to each outlet. This is only fair dealing, but gives point to false accusation of deliberately withholding production from the public."

A manufacturer may be unjustly accused of stock-piling when he is only storing partly finished products while awaiting some vital part, Mr. White explained. For example, refrigerators are being shipped without metal ice trays. These will have to be installed later by the distributor or dealer before the refrigerators can be sold. A range manufacturer is producing and stock-piling electric ranges and holding them for the heating elements which must, because of a strike in the plant of the heating unit manufacturer, be put in later at extra cost.

Mr. White, spokesman for the 100 appliance manufacturers who are members of the National Electrical Manufacturers Association, pointed out that the electrical manufacturing industry throughout the nation was one of the largest suppliers to the military services during the war and that many appliance manufacturers faced a 100 percent reconversion problem when the war ended.

"Nevertheless," he continued, "recon-

Continental-Diamond
Engineered Non-Metallic Materials

The DILECTO punched part illustrated is a stator for an aircraft booster switch. It must of course have high dielectric properties. It must also be strong enough to support current carrying parts, and not deteriorate from vibration and impact shock. Its dielectric properties must be stable regardless of temperature, humidity or dryness. Finally it had to be made from a material that could be accurately punched. DILECTO met all these requirements with a wide margin of safety.

KE-45

There are many grades of DILECTO. Each developed to meet specific electrical, mechanical, chemical or thermal problems. Special grades can be developed to meet unusual problems. DILECTO is also available in combination with Diamond Fibre to still further enlarge its sphere of usefulness. This C-D NON-metallic may be the answer to your "What Material?" problem, in your present and future products, whether used in the air, on land or sea.

C-D PRODUCTS

The Plastics

DILECTO—A Laminated Phenolic.
CELORON—A Molded Phenolic.
DILECTENE—A Pure Resin Plastic Especially Suited to U-H-F Insulation.
HAVEG—Plastic Chemical Equipment, Pipe, Valves and Fittings.

The NON-Metallics

DIAMOND Vulcanized FIBRE
VULCOID—Resin Impregnated Vulcanized Fibre.
MICABOND—Built-Up Mica Electrical Insulation.

Standard and Special Forms

Available in Standard Sheets, Rods and Tubes; and Parts Fabricated, Formed or Molded to Specifications.

Descriptive Literature

Bulletin GF gives Comprehensive Data on all C-D Products. Individual Catalogs are also Available.

DISTRICT OFFICES
NEW YORK 17 • CLEVELAND 14 • CHICAGO 11
SPARTANBURG, S. C. • SALES OFFICES IN PRINCIPAL CITIES

•

WEST COAST REPRESENTATIVES
MARWOOD LTD., SAN FRANCISCO 3

•

IN CANADA:
DIAMOND STATE FIBRE CO. OF CANADA, LTD., TORONTO 8

Continental-Diamond FIBRE COMPANY

Established 1895.. Manufacturers of Laminated Plastics since 1911—NEWARK 15 • DELAWARE

version in the industry is proceeding about as planned. Actual appliance production, however, has been seriously delayed by unforeseen bottlenecks such as extensive retrainng of labor, labor shortages and work stoppages in appliance plants and in those of suppliers.

"Few people realize that almost every electric appliance is manufactured by the assembly of previously manufactured sub-assemblies. Some of these items in themselves are the manufactured products of other industries. Any delay anywhere along the line due to shortage of essential material or labor carries through to the production of the finished product. Manufacturing, like distribution, is a pipeline operation and for continued output the pipeline must first be filled and then kept flowing. Curtailed production in a steel mill or a coal mine furnishing coal to make steel is reflected later in the production of motors, and this delay in turn affects the production and shipment of appliances.

"Naturally we are not manufacturing and delivering appliances as fast as either the public or we in the industry would like to do. The appliance business is one of the nation's most competitive and no manufacturer could risk withholding his product from distributors and dealers who might immediately seek franchises from another manufacturer. But the industry now has generally broken the reconversion bottleneck. If given steady sources of supply and uninterrupted production, it soon can produce appliances in quantity to meet the demand that has been growing for four years."

•

Coaxial Cable Involved in Bell System Program

A series of the newest type of microwave radio relay stations, for television, sound programs, or long distance telephone calls, is to be constructed between Chicago and Milwaukee, the American Telephone & Telegraph Co. has announced.

Bell System's construction program calls for the addition each year for the next few years of upwards of 1,500 miles of the coaxial cable.

The radio relay system, which will cost about $500,000, is expected to be ready for tests in the spring of 1947. The terminals for the system will be at the Illinois Bell Telephone Co. long distance center in Chicago and at the Wisconsin Telephone Co.'s toll building in Milwaukee. There will be three radio repeater stations along the way, one near Barrington, Ill., another also in Illinois but near Wilmot, Wis., and the third near Prospect, Wis.

Field Reports on Business

Inquiries for a wide variety of electrical equipment are being received, but actual orders are spotty. Street lighting is one of the outstanding items in the electrical picture, with considerable modernization taking place. Retail trade throughout the country is making record-breaking sales.

CHICAGO

Current and projected programs of plant construction for 1945 to date in the Chicago metropolitan area total $143,000,000, (against $80,000,000 last year), not counting a known but not yet officially announced backlog of $125,000,000, to be revealed shortly after the first of the year, which includes $50,000,000 worth of plant expansion by U. S. Steel Co. Actual execution of the plans, however, has been slowed considerably by the scarcity of labor and materials. Metal trades predominate in this growth, followed by chemical, pharmaceutical, paper processing and electrical products. Bidding on most war plants is running high, in some cases three times the intrinsic worth of the property, due to the delays, high cost and other difficulties involved in new construction.

A. O. Smith Co. will produce household appliances in a new $2,000,000 plant, under construction near Kankakee, Ill. Zenith Radio Corp. factory has been enlarged to increase productive capacity to 15,000 sets daily.

Heralding a new trend in department store operation, Marshall Field & Co. has obtained post-war priority No. 1 for the purchase of a G.E. intrastore television system. Two midwest firms, General Tire & Rubber Co., Akron, Ohio, and Liquid Carbonic, Chicago, Ill., have joined to produce the new Frostor electric refrigerator in a new million dollar plant at Morrison, Ill. Stewart-Warner has obtained OPA approval on retail prices of 13 home radios and expects to be in full or partial production on all models within 60 days, reaching a capacity output of 5,000 sets per day. About 10,000 of the two lowest priced plastic table models will be in dealers' hands by Christmas.

PACIFIC COAST

It is conservatively predicted that rail-water shipments will be a factor in Pacific Coast business by February. Inventories should be very spotty due to shortages of many critical items and fairly sizeable residues of war-time items.

A variety of merchandising devices is now arriving in major coast cities, but in quantities so small as to furnish samples only instead of making a nucleus for sales.

Orders include overhead line equipment, field coils, armatures, and trolley wire for municipal railroad of San Francisco; 52 miles of transmission line coating in Clallum County, Wash.; a $232,687 award for 280 miles of REA transmission line to Monte Vista, Colo.; $193,000 allotted for lines in Lincoln County, Colo.; and 163 miles planned for north-eastern Idaho.

Office and assembly buildings will constitute first unit of plant at El Monte, near Los Angeles, for manufacturing Thor washers. 5,300 poles with insulators, hardware, and wire to proportionate scale will be required for the 265-mile network in Wasco and Sherman Counties, Ore.

Industrial developments include awards for the $3,000,000 United Rexall Drug Building in Los Angeles; $350,000 each for new equipment for Rheem Mfg. at Richmond and Food Machinery Corp. at San Jose; location of Colonial Radio, a Sylvania subsidiary, at Riverside, Calif.; plans for $1,000,000 for an icehouse and shipping sheds at Salinas; and a $2,500,000 gas reduction plant for General Petroleum at Fresno.

NEW YORK

Business generally is moving ahead slowly but consistently, in the shift from war to peacetime production, though shortages of manufactured materials and uncertain labor conditions are retarding factors.

Civil engineering construction volume in continental United States totaled $67,642,000 for the week ending December 13, 1945, as reported to *Engineering News-Record.* This volume was 16 percent below the volume for the preceding week and was 113 percent greater than the volume for the corresponding week last year. Private construction, while dropping 12 percent below the preceding week's figure, continued to gain and the week's figure was 1,124 percent greater than the corresponding week of last year. The week's construction brought the 1945 total cumulative figure to $2,199,382,000 for the 50-week period, a 30 percent increase over the total for the similar period of 1944.

Predictions that department store volume would be limited only by merchandise scarcities were fulfilled in the Metropolitan area last week, when Christmas trade proceeded unabated.

NEW ENGLAND

Inquiries for electrical equipment are being received in large numbers, principally with an eye to deliveries, but actual orders are spotty. Industrial heating interest is gaining and infra-red projects are being studied by a number of companies in connection with speeding up 1946 output.

Cambridge Steam Corp., subsidiary of Cambridge Electric Light, has petitioned the city council for permission to erect a $3,000,000 steam plant.

A circuit breaker order, amounting to $16,198 has been booked for Allis-Chalmers' Hyde Park plant. Bangor (Me.) plans an extension of its street lighting system in 1946 and Taunton (Mass.) will replace present lighting with modern high intensity street lighting units as part of its post-war improvement program. Raytheon Manufacturing Co., Waltham, Mass., has contracted to build a mobile laboratory for carrying on research in radar and signal fields for the government.

Western Massachusetts Electric Co. is conducting an extensive educational program in anticipation of a large demand for kitchen units, resulting with the resumption of new construction in 1946.

Special holiday decorations are being installed in New England cities. Boston lighting displays will be featured by colored illumination of the State House. New England retails trade is making record-breaking sales, with electrical appliances disappointingly limited to small lots.

"POWER FAILURE AT 24 NORTH BROAD" . . .

1.

Telephone call from Power Company (1) is relayed through local telephone office to transmitter and then by radio to Power Company truck (2). Truck transmits to nearest receiver and is connected by telephone to home office.

"WE'LL BE THERE IN 3 MINUTES!"

2.

The operating companies of the Bell Telephone System have plans under way for extensive trials of general two-way mobile radiotelephone service in many large cities throughout the country — and plans are being made to extend these service trials to highways between cities.

Electric companies will be among the first to realize the advantages of direct voice contact with drivers of mobile equipment — routine repair and inspection work can be expedited, and appropriate vehicles can be made available in case of emergency.

Source of supply for the Bell System since 1882, Western Electric pioneered in mobile radio in 1917 — and Western Electric equipment has led the way ever since. It is natural that Western should play a major part in extending telephone service to the streets and highways of America.

Western Electric

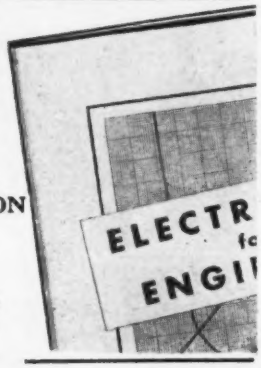
Distributed by Graybar

Western Electric

PIONEERS IN MOBILE RADIO

Buy all the Victory Bonds you can—and keep them!

142 important design articles on electronic equipment and parts



Short-cuts to better DESIGN CONSTRUCTION USE

Charts, graphs, reference sheets, equations, tables

This handy reference book brings to designers, builders and users of electronic equipment and parts a host of valuable aids—material which has been condensed into graphs, charts, and concise articles, to supply you with a short cut to more and better reference data in your field. It contains a multitude of engineering aids related to the design of circuits, equipment and individual parts for radio, electronic, television, facsimile, radar, sound, and related vacuum-tube apparatus—including topics brought into prominence by acceleration of wartime electronic research.

Just published!

ELECTRONICS for ENGINEERS

Edited by JOHN MARKUS and VIN ZELUFF
Associate Editors, **Electronics**

390 pages, 8½ x 11, figures, $6.00

This rich source of data contains over a hundred different articles, each one a "find" for the electronics man who needs concise, easily available information to aid him in his work. It represents design articles, charts, and graphs selected from the complete files of **Electronics** magazine for their value to you, carefully condensed, edited, and indexed, and arranged in easily accessible form.

Here is some of the specific reference material you'll have on hand:

Design Charts for Dissymmetrical T Pads
Design Procedure for Ground Plane Antennas
Harmonic Analysis of Overbiased Amplifiers
Computing Reactive Attenuation
Capacitor Charge-discharge Nomograph
Photographing Patterns on Cathode-ray Tubes
Impedance Determinations of Eccentric Lines
Electronic Heating Design Chart
Grid Control of Industrial Gas-Filled Tubes
Design of Audio Reactors for D-C Service
Chart for Determining Square Root of a Complex Number

SEE IT 10 DAYS ON APPROVAL

McGraw-Hill Book Co., 330 W. 42 St., NYC 18
Send me Markus and Zeluff's Electronics for Engineers for 10 days examination on approval. In 10 days I will send $6.00, plus few cents postage, or return book postpaid. (Postage paid on cash orders.)

Name .....
Address .....
City and State .....
Company .....
Position .....W 12-22-45

(In Canada: Mail to Embassy Book Co., 12 Richmond St. E., Toronto 1).

Sales Opportunities

ILLINOIS—Hiram Walker & Sons, Inc., Peoria, plans extensions in local whiskey distillery, comprising additional buildings with machinery and electrical equipment. Cost estimated close to $2,500,000. Work scheduled to begin soon.

MASSACHUSETTS—Montaup Electric Co., Fall River, has completed plans for proposed addition to steam-electric generating station at Somerset and will begin work soon on new steel frame superstructure. Equipment will be installed for increased capacity. Stone & Webster Engineering Corp., 49 Federal St., Boston, is consulting engineer.

NEW JERSEY—Celanese Corp. of America, Inc., 180 Madison Ave., New York, N. Y., has arranged for purchase of former plant of New Jersey Powder Co., Belvidere, from RFC, for a reported consideration of $1,250,000, and will take immediate possession. Property comprises about 800 acres of land, improved with number of buildings, including main unit of about 100,000 sq. ft. floor space. Structures will be remodeled and improved for plastic products and chemical manufacture, with installation of machinery and electrical equipment for large capacity. Additional buildings also are planned. Entire project will be carried out over period of several months and will represent total investment of about $10,000,000.

OHIO—Philip Carey Mfg. Co., Lockland, Cincinnati, roll roofing, asbestos papers, composition board products, etc., plans expansion in main local plant and branch factories at Middletown, Ohio; Perth Amboy, N. J.; Plymouth Meeting, Pa.; and Canadian plant at Lennoxville, Que. Work will include additional buildings at each plant, with machinery and electrical equipment. Program to be carried out during 1946 will represent total investment of about $5,000,000.

CALIFORNIA—Pacific Gas & Electric Co., San Francisco, has authorized immediate construction of new 220,000-volt transmission line from Shasta power substation to San Francisco Bay district, where new terminal substation facilities will be provided for distribution service. Cost estimated over $5,500,000.

ARIZONA—Bureau of Reclamation, Kingman, plans expenditure of about $30,000,000 for transmission and distribution lines, power substations and other facilities in connection with new Davis dam and hydroelectric generating station on Colorado River, about 67 miles downstream from Boulder dam, vicinity of Kingman. Contract for dam construction, including power house, will be awarded soon and work placed under way; completion is scheduled early in spring of 1949. Station will be of outdoor-type, with rating of 225,000 kw., divided into five 45,000-kw. generators, each operated by a 62,200-hp. hydraulic turbine. A 230-kv. switchyard will be constructed near power plant.

MARYLAND—American Can Co., 230 Park Ave., New York, N. Y., plans new plant for manufacture of tin cans in vicinity of Erdman Ave. and North Point Rd., Baltimore. It will comprise several units, with total floor space approximating 20 acres. Machinery and electrical equipment will be installed for large output. A power substation is planned, with boiler house and other utility structures. Entire program is reported to cost about $6,000,000. Proposed to begin work early next year.

NORTH CAROLINA—Water Dept., Salisbury, plans installation of motor-driven pumping machinery, controls and auxiliary equipment in connection with extensions in waterworks, including new filtration plant and elevated storage tank. Cost estimated over $400,000.

WASHINGTON—Dept. of Public Utilities, Light Division, Tacoma, plans three new power substations, each with rating of about 3,000-kva. City Council has approved program, providing fund of about $130,000 for structures and equipment.

MISSOURI—Ford Motor Co., Dearborn, Mich., has approved plans for proposed new assembling plant at St. Louis, comprising several one-story units, with machinery and electrical equipment for large capacity. Cost about $10,000,000. Work on superstructure will begin at early date. Albert Kahn Associated Architects & Engineers, Inc., New Center Bldg., Detroit, Mich., is architect and engineer.

NEW YORK—American Cyanamid Co., 30 Rockefeller Plaza, New York, industrial and other chemicals, plans new power plant at factory at Pearl River. Work on steel frame superstructure will be placed under way soon.

IOWA—City Council, Des Moines, has authorized extensions and improvements in street-lighting system in various districts, including installation of 27 new 250-watt lighting units, three 400-watt, and 46 new 100-watt. C. C. Green is lighting engineer for city, in charge.

WASHINGTON—Orcas Power & Light Co., Eastsound, has plans for extensions and improvements in generating station at Friday Harbor, including addition to building and installation of additional equipment. Work will be placed under way soon. W. S. McCrea, Jr., Perkins Bldg., Tacoma, is consulting engineer.

ILLINOIS—International Harvester Co., 180 North Michigan Ave., Chicago, is arranging a large expansion program to be carried out over period of number of months. Erection of two new plants at Memphis, Tenn., and Woodriver, Ill., will be placed under way at early date, with completion scheduled in 1946. Each will comprise several large units and will be used for manufacture of farm implements and farm tractors, respectively. Cost reported over $5,000,000, with machinery and electrical equipment. Company has purchased from RFC former Buick Division plant of General Motors Corp., Melrose Park, Ill., and will convert for manufacture of diesel engines for farm tractors. Company also plans two new plants on Pacific Coast for assembling of motor trucks and production of farm implements, respectively. Each will represent investment in excess of $1,500,000. Complete development program is estimated to cost approximately $100,000,000.

•

Buys Utah Radio Unit

The Electro Engineering Co., Oak Park, Ill., has purchased the motor and generator division of Utah Radio Products Co., H. A. Mueller, president of the Electro company, has announced.

WIREMOLD BETTER WIRING FOR BETTER LIGHTING

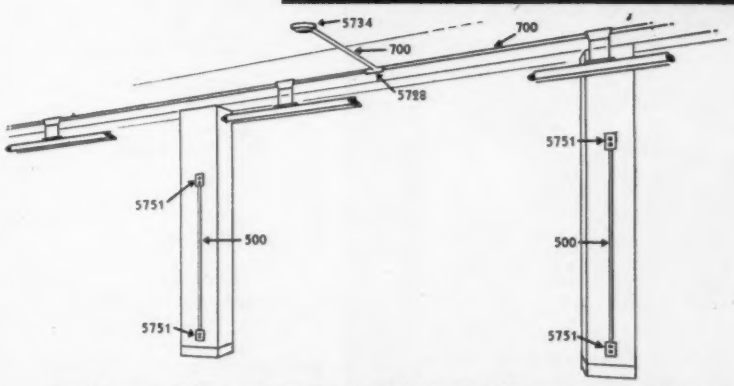
THE INSTALLATION

This photograph of a typical modern office floor in a building having loft type construction, shows the use of Wiremold to provide for proper location of modern fluorescent lighting units, and also on each column to connect with existing wiring to provide outlets for fans and office machines.

WHAT WAS USED

With easily installed Wiremold Raceways and a minimum number of well designed Wiremold fittings, every type of installation may be completed all the way "from panel boxes to outlets". Wiremold is unobtrusive, strong, safe and permanent. Later changes or additions are quickly and easily made.

HOW IT WAS USED



In this case Wiremold No. 500 and No. 700 Raceways and fittings were used throughout. Where additional capacities are required, No. 1000 and larger Raceways may be used interconnecting one with another to provide a complete wiring system. Many office wiring layouts will also use No. 1500 or No. 2600 "Pancake" Wiremold Overfloor Systems for telephone connections to desks and Plugmold plug-in-anywhere Systems to provide convenience outlets for lamps, appliances or machines.

Write for Engineering Data Sheets and other literature showing how and where Wiremold can help you complete your postwar wiring modernization program faster, more effectively and often at lower cost.

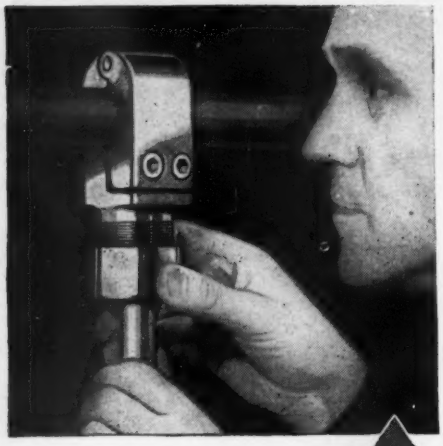
THE WIREMOLD COMPANY . . HARTFORD 10, CONNECTICUT

ELECTRICAL ENGINEERS

ARMY E NAVY

Wiremold Engineering Data Sheets and other literature are designed to help you solve wiring problems. If you are not receiving this literature, send us your name TODAY.

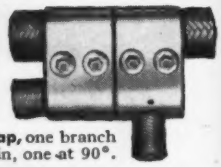
NEMA



It's Easy to pick the right CABLE TAP— from the *Complete* line

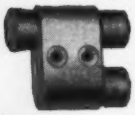
You'll find the widest variety of parallel and 90° taps, combinations, and gutter taps — in a range of sizes up to 1,000,000 cm. Insulating Bakelite covers can be furnished for all types.

Single 90° Tap from main conductor.

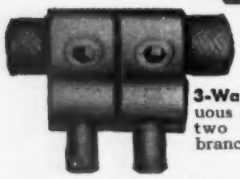


Combination Tap, one branch parallel to main, one at 90°.

2-Way Gutter Tap.



Bakelite Covers can be furnished for all types of Penn-Union cable taps.



3-Way; continuous main and two separate branches.

Also a complete line of Service Connectors, Terminals, Tees, Straight and Parallel Connectors, Grounding Connectors, etc. — every good type of conductor fitting. And every one is accurately made, thoroughly tested — *dependable.*

PENN-UNION ELECTRIC CORPORATION ERIE, PA.

PENN-UNION

Conductor Fittings

REA Allots Funds; Approves Contracts

The Rural Electrification Administration has recently announced the approval of loan allotments totaling $2,711,000 to 16 rural co-ops in 13 states. The loans, which unless otherwise noted will be used for line construction to extend electric service, are listed below:

ARKANSAS—Ashley-Chicot-Union Electric Co-op., Inc., Hamburg, $190,000.

ILLINOIS—Rural Electric Convenience Co-op. Co., Divernon, $185,000, which includes funds for rephasing, substation and transportation equipment.

INDIANA—Parke County Rural Electric Membership Corp., Rockville, $305,000; Sullivan County Rural Electric Membership Corp., Sullivan, $160,000; Kosciusko County Rural Electric Membership Corp., Warsaw, $25,000.

IOWA—Clarke Electric Co-op., Inc., Osceola, $300,000, which includes funds for substation, transportation and working equipment; Butler County Rural Electric Co-op., Allison, $165,000.

KANSAS—Coffey County Rural Electric Co-op. Assn., Inc., Burlington, $101,000.

KENTUCKY—Licking Valley Rural Electric Co-op. Corp., West Liberty, $150,000.

MINNESOTA—Meeker Co-op. Light & Power Assn., Litchfield, $211,000.

NORTH CAROLINA—Union Electric Membership Corp., Monroe, $211,000.

OKLAHOMA—Rural Electric Co-op., Inc., Lindsay, $50,000.

SOUTH CAROLINA—Marlboro Electric Co-op., Inc., Bennettsville, $196,000, which includes funds for headquarters facilities and system improvements.

SOUTH DAKOTA—Hamlin Electric Assn., Hayti, $100,000.

TENNESSEE—Forked Deer Electric Co-op., Inc., Halls, $262,000.

TEXAS—Wood County Electric Co-op., Inc., Quitman, $100,000.

Construction Contracts Approved

FLORIDA—Withlacoochee River Electric Co-op., Inc., Dade City, contract to Bigby Electric Co., Tampa, Fla., 200 miles of line; labor and materials, $178,966; engineer, Moorhead Engineering Co., Ocala, Fla.

INDIANA—Newton County REMC, Kentland, contract to Contracting & Material Co., Evanston, Ill., 100 miles of line; labor and materials, $90,497; engineer, Philip Burns, Indianapolis, Ind.

KENTUCKY — Hickman-Fulton Counties Rural Electric Co-op. Corp., Hickman, contract to L. O. Brayton & Co., Dyersburg, Tenn., 75 miles of line; labor and materials, $74,615; engineer, Ray W. Chanaberry, Louisville, Ky. West Kentucky Rural Electric Co-op. Corp., Mayfield, contract to Guy-Townsend Co., Jackson, Tenn., construction and rehabilitation of 16.1 miles of lines; $15,774; engineer, Ray W. Chanaberry, Louisville, Ky.

MAINE—Denny's River Electric Co-op., Inc., Meddybemps, contract to John Lucas Tree Expert Co., Inc., Portland, Maine, conversion of 24.31 miles of line and construction of 10.25 miles of new line; labor and material, $32,710; engineer, Prentiss & Carlisle, Bangor, Maine.

MARYLAND—Choptank Electric Co-op., Inc., Denton, contract to Edward Baurenschmidt, Baltimore, Md., 208 miles of line; labor and materials, $231,839; engineer, B. O. Vannort, Charlotte, N. C.

MINNESOTA—Beltrami Electric Co-op., Inc., Bemidji, contract to Zontelli Bros., Ironton, Minn., 90 miles of line; labor and materials, $79,955; engineer, Banister Engineering Co., St. Paul, Minn.

MISSISSIPPI — Singing River Electric Power Assn., Lucedale, contract to Birmingham Bldg. Co., Birmingham, Ala., 130 miles of line; labor and materials, $116,578; engineer, Bowman & Bowman, Greenwood, Miss. Capitol Electric Power Assn., Clinton, contract to Triple "D" Electrical Contractors, Jackson, Miss., 40 miles of line; labor only, $14,503; engineer, Bowman & Bowman, Greenwood, Miss. Coahama Electric Power Assn., Clarksdale, contract to Neely Bros., Hollandale, Miss., 20 miles of line; labor only, $9,264.

MISSOURI—Co-Mo Electric Co-op., Inc., Tipton, contract to Douglas Contractors, Ltd., Omaha, Neb., 121.38 miles of line; labor and materials, $121,698; engineer, Frank Horton & Co., Lamar, Mo.

MONTANA—Park Electric Co-op., Inc., Livingston, contract to D. M. Manning, Hysham, Mont., 82.9 miles of line; labor and materials, $99,692; engineer, Montana State Water Conservation Board, Helena.

NEW MEXICO—Otero County Electric Co-op., Inc., Cloudcroft, two contracts to Reynolds Electric Co., El Paso, Texas, one for 17 miles of 33-kv. transmission line; labor and materials, $51,596; another for 70 miles of line; labor and materials, $100,412; engineer, Beavers & Lodal, San Antonio, Texas.

NORTH CAROLINA—Central Electric Membership Corp., Sanford, contract to Ivy H. Smith Co., Jacksonville, Fla., 188.3 miles of line; labor and materials, $182,899; engineer, L. E. Wooten, Raleigh, N. C.

OHIO — Guernsey-Muskingum Electric Co-op., Inc., New Concord, contract to F. W. Owens Co., Louisville, Ky., 281 miles of line; labor and materials, $333,368; engineer, Ralph L. Woolpert Co., Dayton, Ohio.

OKLAHOMA—Northfork Electric Co-op., Inc., Sayre, contract to Reinhart & Donovan, Oklahoma City, Okla., 116.16 miles of line; labor and materials, $104,736; engineer, C. H. Guernsey & Co., Oklahoma City.

SOUTH DAKOTA—Lake Region Electric Assn., Inc., Webster, contract to Carl Swedberg, Wheaton, Minn., 179.9 miles of line; labor and materials, $186,039; engineer, Banister Engrg. Co., St. Paul, Minn.

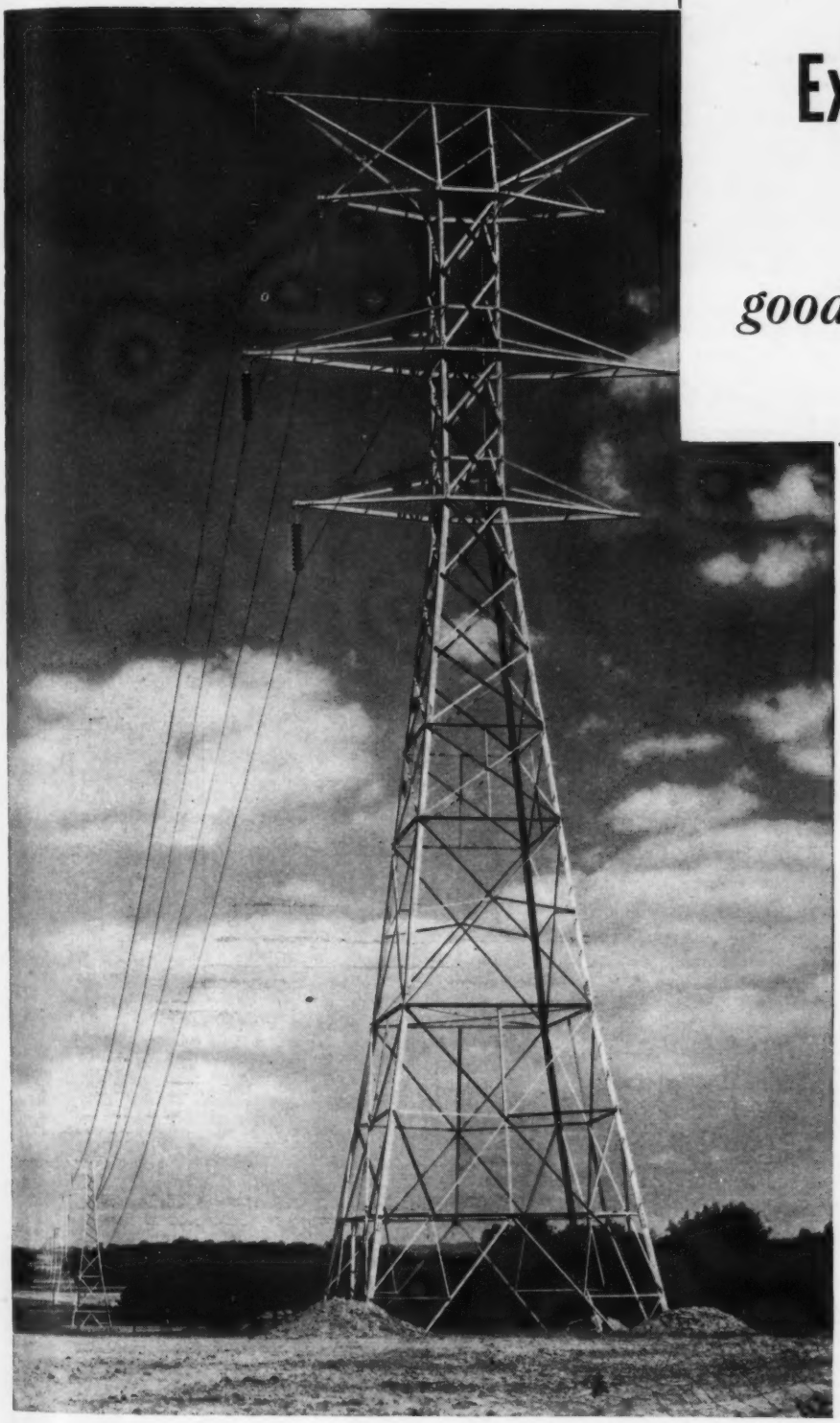
TENNESSEE—Pickwick Electric Membership Corp., Selmer, contract to J. E. Hill Construction Co., Selma, Tenn., 28 miles of line; labor only, $9,718; engineer, Allen & Hoshall, Memphis, Tenn.

TEXAS—Swisher County Electric Co-op., Inc., Tulia, contract to Taylor & Montgomery, Lubbock, Texas, 150 miles of line; labor and materials, $124,951; engineer, N. H. Roberts, Lubbock, Texas. Lamb County Electric Co-op., Inc., Littlefield, contract to Taylor & Montgomery, Lubbock, Texas, 118 miles of line; labor and materials, $95,609; engineer, H. N. Roberts, Lubbock, Texas. Nueces Electric Co-op., Inc., Robstown, contract to C. R. Cento, San Antonio, Texas, 110 miles of line; labor and materials, $91,813; engineer, Southwest Engineers, Houston, Texas.

VERMONT—Vermont Electric Co-op., Inc., Johnson, contract to Kenworthy & Taylor, Everett, Mass., 25 miles of line; $31,236.

VIRGINIA—Powell Valley Electric Co-op., Jonesville, two contracts to Smith Construction Co., Nashville, Tenn., one for 21 miles of 66-kv.; labor and materials, $145,740; the other for 205 miles of line; labor and materials, $232,812; engineer, Sullivan & McWhorter, Nashville, Tenn.

WYOMING—Hot Springs County Rural Electric Assn., Inc., Thermopolis, contract to Olson Construction Co., Salt Lake City, Utah, 102.63 miles of line; labor and materials, $97,150; engineer, H. S. Nixon, Omaha, Neb.



Expert Design

means a good-looking tower

IT is an engineering maxim that "pleasing appearance is inherent in the right design." But it takes an expert to develop that "right design," by efficient utilization of every pound of steel and proper consideration of economies in construction. In this, American Bridge specialists have been particularly successful.

The whole American continent is dotted with the work of our engineers, some of it over the most difficult terrain where climatic and other considerations are most severe.

These towers were designed by our own engineering personnel and fabricated within our own complete plant, which is wholly devoted to the fabrication and galvanizing of all types of transmission towers. Their efficiency was tested at our own proving station, where the largest and most modern Test Frame in the country duplicates field loading conditions to conform with any specified design criteria.

Let us talk with you about your needs. Forty years of accumulated experience is at your service.

EVERY SUNDAY EVENING, United States Steel presents *The Theatre Guild on the Air.* American Broadcasting Company coast-to-coast network. Consult your newspaper for time and station.

AMERICAN BRIDGE COMPANY

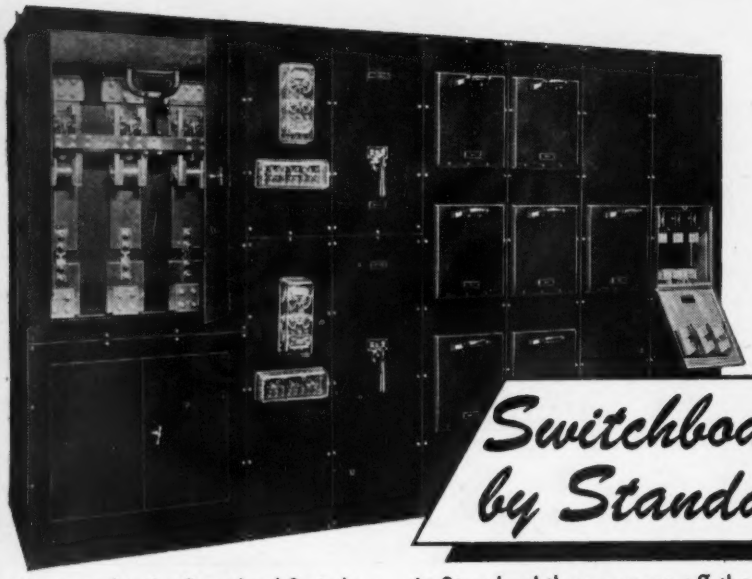
General Offices: Frick Building, Pittsburgh, Pa.

District Offices in: Baltimore · Boston · Chicago · Cincinnati · Cleveland · Denver · Detroit
Duluth · Minneapolis · New York · Philadelphia · St. Louis

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

USS STEEL — UNITED STATES STEEL

UNITED STATES STEEL



Switchboards by Standard

Illustrated is the Standard Switchboard, *Service and Distribution Switchgear*, designed and custom built to meet the particular requirements of one of this country's largest manufacturers of drugs and pharmaceuticals.

At Standard there are no off-the-shelf switchboards. Every panelboard and switchboard is specially designed and incorporates the knowledge and experience gained by many years service to hundreds of switchboard users.

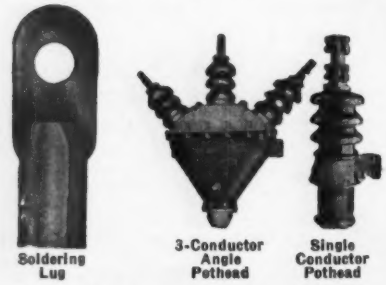
Consult with STANDARD on your Switchboard requirements

STANDARD SWITCHBOARD COMPANY

134-140 Nell St., Brooklyn, N. Y.

ELECTRICAL SPECIALTIES FOR HEAVY INDUSTRIAL SERVICE FROM STOCK

RMC



Soldering Lug | 3-Conductor Angle Pothead | Single Conductor Pothead

Write for a complete selection of RUSGREEN bulletins

ENDULATORS (POTHEADS) ALL SIZES • ALL SHAPES • ALL VOLTAGES • ALL TYPES • BUS SUPPORTS • SPLICING KITS AND MATERIALS • INSULATING COMPOUNDS

★ ★ ★

RUSGREEN MFG. CO.

14260 Birwood Avenue • Detroit, Mich.

ALL the strength and durability inherent in steel are combined---with definite economies---in *Crapo* Galvanized Steel Strand. Heavy, ductile, tightly-bonded zinc coatings, applied by the famous *Crapo* Galvanizing Process, provide lasting protection against corrosion.

Ask the distributor of *Crapo* Galvanized Products near you or write direct for further information!

INDIANA STEEL & WIRE CO.

MUNCIE, INDIANA

Recent Rate Changes

FLORIDA POWER CORP. has made major electric rate reductions to domestic users throughout its entire system, according to an announcement by President A. W. Higgins. He stated it was proposed that the new rates go into effect in January for all meter readings taken on and after February 1, 1946. Mr. Higgins revealed that the money value of the reductions on the present use basis was more than $360,000, of which approximately $90,000 would accrue to St. Petersburg and the gulf beaches. Basically, the proposed rates are: $1 for the first 14 kw.-hr. or less, 5 cents each for the next 36 kw.-hr., 3 cents each for the next 150 kw.-hr., 1½ cents each for all over 200 kw.-hr. The present set-up is: $1 for the first 12 kw.-hr. or less; 6 cents each for the next 48 kw.-hr., 4 cents each for the next 40; 2½ cents each for the next 100 and 1½ cents each for all over 200. The minimum bill is $1.

REDDING (CALIF.) city officials, disclosing that the city has received a reduction on electricity purchased on a five-year contractual basis with Pacific Gas & Electric Co., are making preparations to reduce their power rates. The slash will vary from 14 percent in the residential rates to 5 percent in some other rate blocks, and will effect an overall cut of 10 percent.

NOVO SCOTIA PUBLIC UTILITIES BOARD has reduced domestic rates in Hantsport from 6 to 4 cents per kilowatt-hour; commercial rates from 6 to 5 cents. The board also recommended that a valuation of the system be made and that a depreciation reserve be set up.

TRURO ELECTRIC COMMISSION has petitioned the Nova Scotia Public Utilities Board for permission to reduce domestic and commercial rates in Lower Truro, Princeport and Clifton district. The petition was granted, and the new domestic rates are 4 cents per kilowatt-hour for the first 30 kw.-hr. and thence two cents per kilowatt-hour, with minimum monthly bill of $1.75 and, where an electric range is used, $3.75. The commercial rates call for four cents per kilowatt-hour for the first 100 hours' use of connected load or maximum demand, and thence two cents, with monthly minimum of $1.75.

Rates Down for December

Trenton, Mo., which has a municipal system, reduced its rates 8½ percent for December only.

SUBALOX

LEAD AND ALUMINUM PAINT

Spot or Full Coat for Galvanized Structures. It sticks, it blends.

SUBOX INC.

NORTH ARLINGTON, N. J.

How to design, construct, and calculate performance of

POWER-TRANSMISSION LINES

Just out!

Get in on the postwar boom in rebuilding and expanding transmission lines.....

Here for the first time is a book dealing exclusively with the design, the construction, and the day-in, day-out performance of high-voltage transmission lines—key factor in the tremendous job of conveying electric power. From the engineer's first investigation and cost estimate on a proposed extension of the power transmission system, through working out voltage-drop, tension, and other calculations, to his field work in clearing right of way, erecting wood poles or steel towers and stringing conductor—this book is a sure, authoritative, easy-to-follow guide to transmission line work.

TRANSMISSION LINES

Design, Construction and Performance
By FRED C. DEWEESE
General Engineer, Carolina Power and Light Company

297 pages, 5¼ x 8, 182 illustrations and tables, **$3.50**

With this book an experienced practicing engineer provides a long-needed comprehensive work dealing exclusively with this increasingly important subject. The book presents step-by-step procedures from simple short-line problems through lone high-voltage line problems requiring involved mathematics for their solution, and contains many hitherto unpublished methods of considerable interest and value to the operating engineer.

Here's what the book covers:

- Comparison of copper, copperweld-copper, and A.S.C.R. conductor
- Comparison of single-phase and three-phase circuits
- Tables showing resistance, reactance, and capacitance of the various conductors
- Calculations for voltage drop and power loss
- Methods of analysis for short, medium-length, and long transmission lines
- Auxiliary constants and linear constants
- Constructing the current diagram
- Mechanical properties for copper, copperweld-copper, and A.S.C.R. conductor
- Dimensions of timber used in wood poles
- Design of wood-poles H-frames for high voltage lines
- Sag and tension calculations
- Sag templates, insulators, clamps, vibration-dampers, sectionalizing switches, and other devices

See the book 10 days on approval

McGraw-Hill Book Co., 330 W. 42 St. NYC 18
Send me DeWeese's Transmission Lines for 10 days' examination on approval. In 10 days I will send $3.60, plus few cents postage, or return book postpaid. (Postage paid on cash orders.)

Name .....
Address .....
City and State .....
Company .....
Position ..... W 12-22-45

(In Canada: Mail to Embassy Book Co., 13 Richmond St. E., Toronto 1)

BOOK REVIEWS

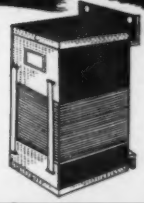
Applied Energy Conversion. By B. G. A. Skrotzki and W. A. Vopat. Published by McGraw-Hill Book Co., New York, N. Y. 509 pages, illustrated. Price $5.00.

Unusual success in merging principles with practice marks this text which ought to produce graduates who will thereby know why power plants, utility and industrial, are put together as they are. Emphasis throughout is on the functional contribution which each major piece of equipment provides. The authors assume that the student (or practicing engineer) knows the rudiments of thermodynamics and the behavior and properties of steam. Therefore it starts with the characteristics of fuels, proceeds to combustion techniques and the steam generators and prime movers. Petroleum engines and hydro plants are treated in the same familiarizing manner before proceeding briefly with binary cycles, gas turbines, wind and tidal power, etc. Then the shift is to the economics of plant investment charges, operating costs and the factors affecting performance. Concluding chapters deal with decisions regarding unit sizes, margins of capacity, load growth and competitive power rates. Problems throughout give a good insight into typical computations in each category cited. The book, for students of any age level, is packed with a notable amount of practical explanation and guidance.

The Efficient Use of Fuel. Edited by J. C. Olsen. Published by Chemical Publishing Co., Inc., New York. 807 pages, illustrated. Price $8.50.

Evidently prepared to meet the fuel stringency in Great Britain during the war, this work is a comprehensive and authentic compilation because it bears the imprint of the Education Sub-committee of the Fuel Efficiency Committee of the Ministry of Fuel and Power. Incomparable data on fuels, combustion, boilers, furnaces (including electric), process steam, drying and instrumentation for control are given. The treatment goes farther and deeper in that it defines and discusses the operations and the equipments and gives helpful advice on how to avert waste, losses and inefficiency. Commendable effort was made throughout to familiarize plant managers and operators with the technology of their field and the ways in which they could observe, understand, and better their use of fuels—solid, liquid and gaseous. Many an American power plant engineer could apply the information with benefit. It is much more a reference work than a textbook.

AIR COOLED POWER TRANSFORMERS



1/10 KVA to 50 KVA Auto and insulated types. Single and three phase. Up to 2300 Volts primary.

Write for Bulletin 160.

Acme ACME Electric
21 WATER ST. CUBA, N. Y.

MATTHEWS DISCONNECTING SWITCHES

Available in ratings of 200, 400 and 600 amperes, 7500 volts. They have high dielectric values and are of the dead blade type. Swivel type hangers permit mounting of switch in convenient position for lineman. Large, high pressure, point type contacts and heavy copper blades assure cool operation at full rated load. Yoke type terminals confine strands of terminal wires. Bakelite doors securely latch in open or closed positions. Quick break blades to prevent burning of contacts can be supplied on the 200 and 400 ampere sizes.

Write for Bulletin 106

W. N. MATTHEWS CORP.
3722 FOREST PARK BLVD.
ST. LOUIS 8, MO.

PROFESSIONAL SERVICES

BARKER & WHEELER

Utility and Industrial Valuations, Design and Construction of Power Systems, Water Supplies, Sewerage and Sewage Disposal, Factory Production and Cost Control Systems.

11 Park Place, New York City
36 State Street, Albany, N. Y.

BLACK & VEATCH

Consulting Engineers

Water, Steam and Electric Power Investigations, Design, Supervision of Construction, Valuation, Tests and Laboratory Service.

4706 Broadway, Kansas City, Mo.

E. J. CHENEY AND CO.

ENGINEERS AND CONSULTANTS

Economic and Business Surveys
Valuations and Reports
Rate and Rate Case Analyses

61 Broadway New York

HUGH L. COOPER & CO. INC.

General Hydraulic Engineering, including the design, financing, construction and management of hydro-electric power plants.

350 Fifth Avenue New York 1, N. Y.

DAY & ZIMMERMANN, Inc.

ENGINEERS

Design - Construction - Management
Investigations and Reports

NEW YORK PHILADELPHIA Packard Building CHICAGO

DOBLE ENGINEERING COMPANY

Electrical Insulation Engineers

Field Testing and Maintenance of High Tension Insulation, Special Problems in Electrical Communications.

Office and Laboratory: Medford Hillside, Boston, Mass.
Branch Office: 20 N. Wacker Dr. Chicago, Ill.

Ebasco Services Incorporated

Industrial Division

Design and Construction
Financial and Operating Consultation
Investigations and Reports
Consulting Engineering

Two Rector Street New York

ELECTRICAL TESTING LABORATORIES INC.

Field and Laboratory Tests
Electrical • Mechanical • Physical
Chemical
INSPECTION • ANALYSIS • RESEARCH
CERTIFICATION

2 East End Avenue at 79th St., New York 21, N.Y.

H. F. FERGUSON

Consulting Electrical Engineer

Expert advice on location and purchase of right of way.
Industrial plant layouts & surveys. Rate comparisons.

288 Alameda Avenue Youngstown, Ohio

ROBERT E. FOLEY CONSTRUCTION CORPORATION

Rural Lines—Transmission Lines
Fire Alarms—Telephone Lines

48 Griswold St. Binghamton, N. Y.

FORD, BACON & DAVIS, Inc.

ENGINEERS

DESIGN • CONSTRUCTION
VALUATIONS • REPORTS
New York—Philadelphia—Washington—Chicago

FRANK F. FOWLE & CO.

Electrical and Mechanical
ENGINEERS

35 East Wacker Drive Chicago, Ill.

PAUL E. GERST & CO.

CONSULTING ENGINEERS

Specialists in
Electrical Product Design
El. Machinery, Apparatus & Applications
El. Appliances, Hi-Frequency Apparatus
Electronics, Radio Communications.

205 W. Wacker Dr. Chicago 6, Ill.

GILBERT ASSOCIATES, Inc.

Engineers and Consultants

DESIGN, CONSTRUCT, OPERATE & MAINTAIN INDUSTRIALS AND PUBLIC UTILITIES
Reports • Rates • Labor relations • Safety • Purchasing • Costs • Laboratory

61 Broadway New York Reading, Pa. National Press Bldg. Washington, D. C.

FREDERIC R. HARRIS, INC.

ENGINEERS CONSTRUCTORS

MANAGEMENT
NEW YORK

Knoxville Houston San Francisco

HENKELS & McCOY

(Electric & Telephone Line Construction Co.)

Wood pole transmission lines
Electric Distribution and maintenance

Philadelphia, Pa.

HOOSIER ENGINEERING COMPANY

Erecting Engineers
Transmission Lines, Substations

46 So. 5th St., Columbus, Ohio
327 South LaSalle Street, Chicago, Ill.
136 Liberty St., New York

WILLIAM S. LEFFLER

succeeding
CHARLES F. LACOMBE—WILLIAM S. LEFFLER
Engineers—Economists
RATE RESEARCH — SALES RESEARCH
FOR
POST-WAR PLANNING
Cost Analysis Rate Cases
Noroton, Connecticut

LUCAS & LUICK

ENGINEERS

DESIGN, CONSTRUCTION SUPERVISION, OPERATION, MANAGEMENT, APPRAISALS, INVESTIGATIONS, REPORTS, RATES

231 S. LaSalle St., Chicago

CHAS. T. MAIN, INC.

Engineers

Boston, Mass.

Electric, Steam and Hydraulic Projects. Investigations, Reports, Designs and Appraisals.

J. H. MANNING & COMPANY

ENGINEERING
SERVICES

120 Broadway, New York

DANIEL W. MEAD
F. W. SCHEIDENHELM

Consulting Engineers

Hydro-Electric Development, Dams, Water Supply, Flood Control, Engineering Problems relating to Water Rights and Water Power Law. Appraisals.

New York City, 50 Church St.

ARTHUR L. MULLERGREN

Engineering-Management

Public Utilities—Natural Gas

Kansas City, Mo.

PUBLIC UTILITY ENGINEERING & SERVICE CORPORATION

Consulting Engineers

Design Operations

Steam—Hydraulic—Gas

231 S. La Salle St. Chicago 4, Ill.

Recording & Statistical Corp.

BILL ANALYSIS—CONSUMPTION STUDIES
THE ONE-STEP METHOD
Bill Frequency Analyzer

102 Maiden Lane New York

SANDERSON & PORTER

ENGINEERS

AND

CONSTRUCTORS

SARGENT & LUNDY

ENGINEERS

140 South Dearborn St.

Chicago, Ill.

STONE & WEBSTER ENGINEERING CORPORATION

Design and Construction
Reports • Examinations • Appraisals
Consulting Engineering

BOSTON • NEW YORK • CHICAGO • HOUSTON
PITTSBURGH • SAN FRANCISCO • LOS ANGELES

THE J. G. WHITE ENGINEERING CORPORATION

Design • Construction • Reports • Appraisals

80 Broad Street, New York 4

WHITMAN, REQUARDT AND ASSOCIATES

ENGINEERS — CONSULTANTS
Power Plants — Industrial Plants
Steam and Electric Distribution Systems
Waterworks and Sewerage
Reports—Plans—Supervision—Appraisals

1304 St. Paul Street Baltimore 2, Md.